VOL. XXXV. No. 2 APRIL, 1952

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THE

MALAYAN

AGRICULTURAL JOURNAL

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Kuala Lumpur.

PRICE $2

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Edited by the Publications Officer with the assistance of
The Publications Committee.

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THE

Malayan Agricultural Journal

APRIL, 1952.

EDITORIAL

Pig Improvement in Malacca. An article in the July, 1950, issue of the Journal described the Department's extension work with pigs in Penang. In this issue, Mr. Barcroft, the Settlement Agricultural Officer, describes the difficulties and eventual successes of the extension programme in Malacca since the war.

In the years just prior to the Japanese occupation of Malaya, the Chinese pig-rearers were becoming increasingly conscious of the advantages of rearing the progeny of a Middle White boar mated to a local Chinese sow. Research work of the Department had shown that the progeny of this cross were capable of giving larger and more rapid live-weight gains than local Chinese pigs, and that there was an increase in the proportion of carcase to live-weight.

At the liberation of Malaya from the Japanese, the officers responsible for the extension services of the Department found that they had again to start from the beginning in advertising and popularising the Middle White—Chinese cross. Mr. Barcroft describes what has happened in Malacca and shows how popular this half-bred pig is becoming.

Budding of Cacao. Because of the shortage of cacao planting material in Malaya and the fact that it will be several years before proved selections of Trinitario material are available for distribution for commercial planting, the Department has decided to multiply Amelonado cacao as rapidly as possible. In addition, although the Department is aware that maximum yield is more likely to be obtained from cuttings than from budded cacao, it has been agreed that to obtain the most rapid multiplication of the material at present available the budding method should be adopted.

In an article on later pages, Mr. Rosenquist, Botanist, explains why, of the four methods of vegetative multiplication tried, the technique of budding in the field has been chosen. He also describes the method used and gives a summary of the results to-date.

Photoperiodism of Rice. Effects on plants of differences of light in different circumstances had been observed for many years, but it was not until 1920 that Garner and Allard of the Bureau of Plant Industry, Washington, following a series of carefully controlled experiments carried out during 1918 and 1919, defined that the relative length of day is a factor of the first importance in the growth and development of plants, particularly with respect to sexual reproduction.

At first it was not believed that these sensitivities would be distinguishable within the small range of the annual cycle of day-length of the tropics, but it has now been amply demonstrated that day-length is an ecological factor of considerable importance even in these low latitudes.

Mr. Jagoe's original pre-war observations and experiments were made in 1937 to 1940, but for various reasons have been a long time appearing in print. His article deals chiefly with the important aspect of the induction of flowering of rice, and shows how sensitive local varieties are to very small differences in length of day. Mr. Jagoe also attempts to define the range of these photoperiod sensitivities, and emphasises the need to examine the effects of the low light intensities at early morning and in the evening.

The study of the effects of day-lengths on growth and maturation of rice is of great interest and importance, and an appreciation of these effects is essential for any full scale programme of padi improvement work.

PULAU GADONG STUD FARM AND ITS ROLE IN PIG IMPROVEMENT WORK IN THE SETTLEMENT OF MALACCA

BY

A. L. BARCROFT,

Settlement Agricultural Officer, Malacca.

Introduction.

The Pulau Gadong Stud Farm was established in the latter part of 1939 for the express purpose of raising stock of pure bred Middle White pigs to be utilised for upgrading the local Chinese pigs. This policy visualised maintaining Middle White boars for crossing with Chinese sows, and eventual multiplication of boars for distribution to accredited pig breeders. Earlier investigations (1 and 2) had shown that Middle White boars when mated to Chinese sows, sire good sized litters capable of giving larger and more rapid live-weight gains than the local Chinese pigs. It was on the results of these investigations that the Stud Farm policy was based.

History.

Any progress made towards the implementation of this policy was nullified by the Japanese occupation of Malaya, during which time the Stud Farm suffered considerable neglect, and was practically denuded of Middle White stock. In late 1945, when the Japanese surrendered, the task facing the Department was essentially concerned with the general rehabilitation of the Stud Farm itself, and the fresh introduction of pure bred Middle White pigs. This programme of rehabilitation and replacement of stock was beset by many difficulties, and it was not until 1949 that the Department was in a position to implement, on an extensive scale, the prewar policy previously indicated.

Post War Policy.

During the period 1946 to 1949, minor amendments to the prewar policy were made, but basically this remained unchanged. The prevailing policy in 1949 was directed towards the multiplication of Middle White boars for eventual distribution to Chinese pig rearers for breeding purposes. At this time, however, the pig rearing industry was experiencing considerable hardships—mainly on account of scarcity and/or high cost of feeding stuffs—and consequently under these circumstances the tendency of rearers was to reduce the number of breeding sows in their possession rather than increase their herds by the introduction of Middle White boars. A further and probably more serious factor mitigating against the ownership of Middle White boars, or boars of any breed for

that matter, was the prejudice prevalent amongst pig rearers in the Settlement of Malacca whereby such ownership and use for stud purposes was considered undignified. From enquiries made, it was also apparent that the majority of the rearers had yet to be fully convinced of the superiority of the Middle White Cross over the pure bred Chinese pig for rearing purposes.

These factors, jointly and severally, were responsible for the absence of demand for Middle White boars, and it was obvious that in order to implement the basic policy of distributing these boars to rearers the Department must undertake considerable preparatory work, the ultimate object of which would be the creation of a demand for stud boars. Initially, it was considered necessary to demonstrate the superiority of the Middle White Cross over the pure Chinese pig for rearing purposes. When this had been successfully accomplished it was confidently anticipated that a demand for serving Chinese sows with Middle White boars would naturally arise and, furthermore, that the local prejudice regarding ownership of boars at stud by individual rearers would, in time, eventually disappear. Demonstration of the behaviour of Middle White cross-bred pigs could best be achieved by encouraging rearers to bring their breeding sows to the Stud Farm for service by Middle White boars. Thereby the rearers themselves would be in a position to witness personally the performance of the Middle White cross-bred pigs from birth to maturity, under conditions typical of Chinese management.

Review of Progress.

(27th June, 1949, to December, 1951)

On account of the lean time experienced by the pig rearing industry in 1948 and 1949, there was an initial atmosphere of general disinterestedness on the part of the rearers towards the Department's programme. Nevertheless a small number of rearers signified their willingness to cooperate with the Department. Thus a start was made with the proposed programme, and the first Chinese sow was brought to the Stud Farm for service on the 27th June, 1949. Thereafter the number of Chinese sows brought for service gradually increased month by month, and after the first cross-bred litters had been farrowed and were in the process of being reared, the demand for serving Chinese sows with Middle White boars showed a very marked increase. It was therefore necessary to increase the number of boars in order to meet the growing demand, and by the end of 1951 four Middle White boars were available for stud purposes.

The success of the Department's extension policy can be gauged not only by the popularity which it enjoys amongst the pig rearing community, but also by the increasing demand for Middle White boars from rearers and from itinerant boar keepers. It was possible, to a limited extent, to satisfy the demand from rearers, but on account of the necessity of multiplying and maintaining Middle White boars for future introduction into New Villages, distribution to private rearers had to be suspended in-

definitely. During the period under review six Middle White boars were distributed, of which one went to the Onn Lok New Village in the Jasin District, and the remainder to private rearers.

Records Maintained

Comprehensive records of all stud services performed and all cross-bred litters farrowed were maintained throughout the period under discussion. In respect of individual stud services, the following information was recorded:—

(a) Reference number of sow.
(b) Date served.
(c) Breed.
(d) Boar used.
(e) Owner's name and address.
(f) Date expected to farrow.

Subsequent to farrowing of individual cross-bred litters the following information was recorded.

(a) Reference number of sow.
(b) Date served.
(c) Date farrowed.
(d) Gestation period in days.
(e) Litter size at birth.
(f) Litter size at 3 weeks of age or more.

Services Performed by Middle White Boars

Table I shows the number of services performed by Middle White boars at the Stud Farm:—

Table I.

Number of Recorded Services at Pulau Gadong Stud Farm.

Year.	Breed of Sow.			Total.
	Chinese.	Half-bred Middle White.	Middle White.	
1949	34	—	3	37
1950	118	2	—	120
1951	198	4	1	203
	350	6	4	360

In addition, Middle White boars in the possession of private rearers performed 23 services during 1951, thus bringing the grand total for the

recorded period to 383. The ever increasing popularity of the facilities extended to the pig rearing community by the Department, and of the rearing of cross-bred litters is indicated by the figures presented in Table I. Enquiries revealed that this popularity is based mainly on the fact that the Chinese sow, when crossed with a Middle White boar, produces vigorous offspring, inheriting virtually all the desirable characteristics of the sire and capable of being reared to maturity more rapidly than Chinese pigs although fed on similar rations. Rearers have stated that whilst it would take anything from 9 to 12 months to rear Chinese pigs to one picul live weight, with the Middle White Crossbreds this can be accomplished in 7 to 8 months. Furthermore, the butchers appear to prefer the Middle White Crossbred, as the carcase quality and dressing percentage is superior to that obtained from Chinese pigs.

Services of Individual Middle White Boars.

The number of stud services performed by individual Middle White boars maintained at the Stud Farm is given in Table II.

Table II.

Individual Stud Services.

Year.	Reference Number of Middle White Boar.					Total.
	C.H. 244	P.G. 22	P.G. 31	C.H. 10	P.G. 2/51	
1949	37	—	—	—	—	37
1950	84	36	—	—	—	120
1951	77	47	61	13	5	203
	198	83	61	13	5	360

Health of all boars during the period reviewed was satisfactory with the exception of Boar P.G. 22 which, in September, 1951, showed a marked deterioration in condition and was destroyed. Post-mortem examination revealed the cause of deterioration to be osteoporosis. With proper feeding and adequate facilities for outdoor exercise, experience has shown that mature Middle White boars can perform a minimum of 70 to 80 stud services per annum without any adverse effects on health.

Details of Cross-bred Litters Farrowed.

Records of all cross-bred Middle White litters farrowed were maintained, and these are shown in Table III.

Table III.

Numbers and Details of Middle White Cross-bred Litters.

Year.	Number of Chinese sows farrowed.	Total cross-bred litter at birth.	Total litter at 3 weeks old	Males.	Females.	Average number of pigs per litter at 3 weeks of age.
1949	12	146	115	62	53	9.58
1950	96	1,126	997	526	471	10.38
1951	152	1,722	1,537	784	753	10.11
	260	2,994	2,649	1,372	1,277	10.18

The total cross-bred litter at birth included a number of stillborn pigs, and consequently the casualty rate between time of farrowing and three weeks of age is lower than indicated by the figures given in Table III. As the majority of rearers are active agriculturalists it was not always possible for them to be present when their breeding sows farrowed, and in these instances there was occasionally some doubt, on finding dead pigs in the litter, as to whether these were stillborn or had succumbed soon after birth. It was also learnt that many rearers did not attend their sows when these farrowed overnight, and similar doubts arose. It was quite impossible for the Field Staff to be present at every farrowing, and thus the litter size at birth could only be ascertained from the rearers themselves. The commonest cause of litter casualties between birth and three weeks of age appeared to be overlaying by the sow. Nevertheless, although the total litter at birth included a number of stillborn pigs, the casualty rate from birth to three weeks of age of approximately 11.5 per cent., or about 1 in 9, is not a matter for serious concern as the average number of pigs per litter surviving at 3 weeks of age was satisfactory. There is no doubt, however, that the casualty rate could be reduced by more efficient management, particularly in respect of feeding of breeding sows prior and subsequent to farrowing, and greater care of both sow and litter after farrowing.

Progeny Records of Stud Boars.

Progeny records of individual Middle White boars were maintained and these are given in Table IV.

General

Chinese sows brought in for service occasionally showed marked differences in general appearance and condition, this factor no doubt contributing towards the large variation in number of pigs per litter. Litter size ranged from 2 to 21, with an average of approximately 10 pigs per litter at three weeks of age.

Table IV.

Progeny Records of Individual Middle White Boars.

Boar.	Year.	Number of Chinese sows farrowed.	Total cross-bred litter at 3 weeks.	Males.	Females.	Average number of pigs per litter at 3 wks. of age.
CH. 244	1949	12	115	62	53	9.58
	1950	80	843	445	398	10.54
	1951	58	602	304	298	10.38
	Total	150	1,560	811	749	10.40
PG. 22	1950	16	154	81	73	9.63
	1951	60	611	324	287	10.18
	Total	76	765	405	360	10.06
PG. 31	1951	33	314	150	164	9.51
CH. 10	1951	1	10	6	4	10.00
GRANT TOTAL		260	2,649	1,372	1,277	10.19

The average gestation period in respect of the 260 Chinese sows which farrowed during the period reviewed was 112.4 days, there being 128 sows with a gestation period of 112 days, 80 sows with 113 days, 23 sows with 114 days, and 14 sows with 111 days, the remainder falling within the range of 103 to 120 days.

Proposals for Future Work.

It is suggested that the programme discussed in this article be continued, but with greater emphasis on the multiplication of pure bred boars for eventual distribution to New Villages in the initial instance, and thereafter to private rearers. Emphasis has previously been given to encouraging pig rearers to have their breeding sows covered by Middle White boars, with the main object of popularising the rearing of Middle White cross-bred pigs. This object is being rapidly attained, and a demand for Middle White boars has arisen. Hence, in order to satisfy this demand, occasioned by the preliminary work described, the multiplication of breeding boars must be an essential feature of future policy. The

Settlement Government has recently approved funds for the purchase of one Middle White boar and two Middle White gilts, to be imported from the United Kingdom, and with the arrival of this additional stock the breeding and multiplication of boars will be considerably accelerated.

In 1952, distribution of stud boars to New Villages will be given priority in view of the urgent necessity of reviving agricultural production in these areas. A programme has been drawn up which provides for the construction of Stud Centres in eight New Villages where pig rearing is a feature of the agricultural economy, each centre being supplied with a Middle White boar. By the end of 1951, one stud boar had been supplied to Onn Lok New Village in Jasin District, and it is confidently anticipated that in 1952, stud boars will be introduced into the remaining seven New Villages. On account of the proximity to the Stud Farm and the ease of transportation of sows, the programme discussed has been mainly confined to the Central District of Malacca, but with the resettlement of squatters an excellent opportunity has been provided for the extension of this work to the Alor Gajah and Jasin Districts of the Settlement.

Thus, with the continuation of the present programme and the distribution of stud boars to New Villages throughout Malacca, the pig rearing community will possess a firm foundation on which to build a successful and profitable industry, beneficial not only to the rearers themselves, but also to the agricultural economy of the Settlement.

References.

1. T. D. Marsh and N. Kanagaratnam. Pig Husbandry and Preliminary Feeding Trials at the Stock Farm, Serdang. *Malayan Agricultural Journal* Vol. 26, No. 3, 1938.

2. C. W. S. Hartley. A Feeding Trial with Half-Bred Pigs in Penang. *Malayan Agricultural Journal* Vol. 27, No. 9, 1939.

NOTES ON THE BUDDING OF CACAO

BY

E. A. ROSENQUIST,

Botanist.

Introduction.

The commercial planting of cacao in Malaya is at present restricted by the amount of good quality planting material which is available. Some of the world's best planting material is being imported, and already over 2,000 seedlings from 24 different Trinitario clones have been planted in the field at the Federal Experiment Station, Serdang. Before any of this material can be distributed it must be selected and the selections proved. It will therefore be several years before either clones or clonal seed from this imported material become available for distribution.

The Amelonado cacao imported in December, 1949, (1) has, in general, grown well under local conditions. Furthermore the first pods produced have been of satisfactory quality. Amelonado cacao is more homozygous than Trinitario cacao and is normally propagated by seed. It has therefore been decided to multiply this Amelonado type as rapidly as possible, and to establish seed gardens throughout the Federation. The original importation has only just started to produce seed and in order to hasten the establishment of the seed gardens, vegetative propagation is being employed. The experience gained will be invaluable when the time comes to multiply selected and proven Trinitario clones.

The following four methods of vegetative multiplication have been tried: (i) standard cuttings (Fig. 1), (ii) single-leaf cuttings (Fig 2), (iii) budding stocks in baskets (Fig. 3) and (iv) budding stocks in the field (Fig. 4).

In order to obtain maximum yield it seems likely that cuttings are superior to buddings, although the difference between the two is not great (2).

To get the Amelonado seed gardens established as soon as possible, rapid multiplication of the available material is even more important than the ultimate high yield. "Standard" cuttings require 9 to 12 ins. of stem carrying five or six leaves. Single-leaf cuttings require 1½ to 2 ins. of stem carrying one leaf. Although single-leaf cuttings take rather longer to reach the stage at which they are ready for field planting, multiplication is more rapid than with "standard" cuttings.

Buddings, however, have been found to give even more rapid multiplication than single-leaf cuttings. This is partially because the technique adopted for budding is more successful than the technique adopted for taking single-leaf cuttings, and also because initial growth of the buddings is more rapid.

Fig. 1

A fan cutting two months after hardening. (Serdang).

Fig. 2

A single leaf cutting two months after hardening. The original leaf is hanging over to the left of the basket.

Fig. 3

A budding on a stock in a basket about two months after budding. (Serdang).

Fig. 4

A budding on a large stock in the field, about two months after budding. (Degong).

Fig. 5

A budding on a large stock in the field about three months after budding. The stock is cut back at this stage. (Degong.)

Fig. 6

A budding in which the stock has been cut back to about 10 ins. above the point of bud insertion. (Degong.)

Fig. 7

A budding in which the bud was induced to develop by ring barking the stock above the bud insertion.
(Ayer Itam, Penang).

Fig. 8

A three year old budding showing the point from which the rootstock has produced numerous shoots. The shoots have been pruned off. (Serdang).

Budding stocks in baskets has not proved as successful as budding larger stocks in the field. To achieve most rapid vegetative multiplication, budding in the field has therefore been adopted as a standard procedure.

The only Agricultural Station at present equipped to root cacao cuttings is the Federal Experiment Station, Serdang. The transport of cuttings in baskets from Serdang to the more distant parts of the Federation presents a major problem. Budwood can, however, easily be distributed by air, passenger train or bus. This is a further reason for putting the emphasis on buddings rather than cuttings.

There is, however, one major criticism of buddings. Cacao buddings produce numerous shoots which develop from the rootstock below the bud (Fig. 8), and constant pruning is required to ensure that these shoots are not allowed to develop. Cacao is, in this respect, unlike rubber, where shoots from the root stock are comparatively rare. The tendency for cacao to produce shoots from the rootstock is one of the main reasons why cuttings are to be preferred for commercial planting.

Method of Budding Cacao.

Keeping (3) has already described the first attempts to bud cacao in Malaya. The work which he started has been continued, and it is proposed to summarise some of the results which have been obtained. No formal experiments have been conducted and these notes merely report experience that has been gained.

The method of inserting the budpatch into the stock (Diagram 1) is as follows:—

Two vertical incisions, 1 in. long and ½ in. apart, are made in the stock 6 ins. from the ground. A horizontal cut is then made to connect the top of the two incisions and a tongue of bark is peeled down to expose the wood of the stock.

A length of budwood with swollen, but not bursting, buds is selected. A budpatch complete with subtending wood, is then cut out from it. This is trimmed to fit exactly into the recess prepared in the stock. The subtending wood on the inside of the budpatch is carefully removed so that the bud trace is not damaged.

When the budpatch has been so prepared it is neatly inserted into the recess in the stock. The tongue of bark is placed back over the patch and trimmed so that it does not cover the actual bud. The budpatch is bound into position with raffia or grafting tape. After 18 days, the raffia is cut away and the patch examined.

If the stock is in a basket, it is cut back to within ½ in. of the bud seven days later. After about one month the bud begins to develop. (Fig. 3).

If the stock is in the field, the top of the stock is bent over, away from the budpatch. A peg is used to hold the top of the stock to ground. The bend in the stock should be as near to the budpatch as possible (Figs. 4 and 5). When the bud has developed to about 12 or 18 ins. and is carrying a hardened flush of leaves, the stock is cut back to about 12

ins. above the bud insertion (Fig. 6). Finally, when the budding is well established the stock can be cut back to within ½ in. of the bud insertion (Fig. 13).

These techniques were adopted after it had been found that, even after a successful union between the stock and scion had been obtained, (a) a budding on a basketted stock often remained dormant unless the stock was cut right back, and (b) a stock in the field died if cut back before the bud had properly developed. For budding stocks in the field, ring barking above the bud was tried but did not give such good results as bending (Fig. 7).

The size of the budpatch and the height of insertion are adjusted according to the size of the stock and the diameter of the budwood available. Shoots from the rootstock are rubbed off as soon as they appear.

Results of Budding.

Using the methods described above, the following results have been obtained:—

1. *Budding Stocks in Baskets at the F.E.S., Serdang.*

On the 15th January, 1951, a total of 291 healthy Trinitario seedlings, about one year old and growing in baskets, were budded with Amelonado budwood. This budwood consisted of watershoots developing from seedlings growing in the field. After 18 days there were 279 successful unions (96 per cent.) and after two months there were 238 buds developing (82 per cent.). The subsequent growth of the buddings was rather slow. They were despatched to the East Coast where they are growing moderately well.

2. *Budding Stocks in the Nursery at the F.E.S., Serdang.*

It was desired to establish an Amelonado budwood area in the Nursery at Serdang without cutting down any of the few Amelonado seedlings growing in Malaya. Accordingly, in June, 1951, single buds were collected from some Amelonado seedlings growing in the field. The seedlings were about 18 months old and had a diameter of 1 to 1½ ins. A single bud was taken from the main stem of the seedlings, and the area of wood so exposed was painted over. The seedlings did not appear to suffer from this treatment. The single buds so collected were placed in a box of moist coconut fibre and carried to the Nursery. In the Nursery, stocks which were about one year old and planted 6 ft. by 4 ft. were budded. From 261 buddings there were 252 unions (96 per cent.). At the end of August, 146 buds were developing (56 per cent.), and an unknown number developed subsequently. Considering the unorthodox method of collecting the buds, and the fact that July and August are dry months, the result was considered satisfactory.

3. *Budding Stocks in Baskets and in the Field at Sungei Udang.*

On the 27th June, 1951, a total of 196 stocks were budded with standard Amelonado budwood at Sungei Udang Agricultural Station, Malacca. There were 89 Trinitario stocks which were about 18 months old and 107 Criollo stocks which were about 15 months old. Some of

DIAGRAM I.

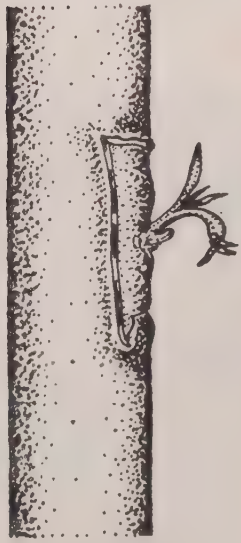
Budpatch

Prepared budwood

Recess prepared in stock

Budpatch inserted into stock

Budpatch bound to stock



Raffia removed

the stocks were in baskets and some in the field. The results are summarised in Table I.

Table I.

Results of Budding Stocks in Baskets and in the Field.

	Stocks in baskets				Stocks in the field			
	Criollo		Trinitario		Criollo		Trinitario	
	No.	Per cent.	No.	Per cent.	No.	Per cent.	No.	Per cent.
No. of buddings -	79	—	30	—	28	—	59	—
Successful unions	62	78	27	90	24	86	57	97
Final successes -	34	43	24	80	22	79	53	90

These results suggest that

(a) Trinitario stocks are easier to bud with Amelonado than are Criollo stocks and

(b) stocks in the field are easier to bud than stocks in baskets.

A formal experiment using stocks which have received uniform treatment is required to confirm these impressions.

The buddings on Trinitario stocks in the field developed remarkably well. Figs. 11, 12, 13 and 14 illustrate the growth of some of these plants in the ten months after budding.

4. *Budding Stocks in the Field at Degong.*

Between the 27th October, 1951, and the 12th January, 1952, a total of 1,654 Trinitario stocks at Degong Agricultural Station, Perak, were budded with Amelonado. The stocks had been planted in April, 1950, and were growing extremely well; they averaged over 6 ft. in height and had a diameter of 1½ to 2 ins. The buddings were made 24 hours after the budwood had been collected from the budwood area at the Federal Experiment Station, Serdang.

The results on the 27th February, 1952, were as follows:—

No. of buddings	....	1,654
Successful unions	....	1,527 (92 per cent.)
Buds developing	....	1,349 (82 per cent.)

The buddings made in October, 1951, were growing well and had reached a height of about 5 ft. in March, 1952 (Figs. 6 and 9).

In view of the size of the stocks, the bud was inserted 9 to 12 ins. above the ground—rather higher than usual. The bark of the stocks was considerably thicker than the bark of the budwood. When the budpatch was inserted into the stock, it was found necessary to insert some padding between the budpatch and the raffia binding in order to hold the budpatch firmly in position.

Fig. 9

A five month old budding. The shoot is supported by a stake. (Degong.)

Fig. 10

A four month old budding. The stock cut back to 12 ins. is to the left of the shoot. (Bukit Mertajam).

Fig. 11

A ten month old budding on a Trinitario stock. (Sungei Udang.)

Fig. 12

A ten month old budding on a Criollo stock (Sungei Udang).

Fig. 13

A ten month old budding on a Trinitario rootstock. The stock has been cut right back. (Sungei Udang).

Fig. 14

A ten month old budding on a Trinitario rootstock. Two buds were inserted into the one rootstock. (Sungei Udang).

Fig. 15

A fifteen year old tree felled in November. One watershoot budded and cut back. The second watershoot not yet budded. (Temerloh).

Fig. 16

A fifteen year old tree felled in November. One watershoot budded seven weeks previously has been cut back and produced a 12 ins. shoot. The second watershoot not yet budded. (Temerloh).

5. *Rejuvenating Old Cacao by Budding at Temerloh.*

At Temerloh Agricultural Station, Pahang, a block of Trinitario cacao, 15 years old, was examined and found to contain no trees worth selecting. The old trees were therefore felled in November and December, 1951, with the intention of budding, with Amelonado buds, any watershoots that were produced.

From 105 trees felled, only five failed to produce watershoots within eleven weeks. Two watershoots were allowed to develop from each stump. The average lengths of the watershoots from 3 to 13 weeks after felling are given in Table II. Once a watershoot appeared, its growth rate was of the same order as that given for Tree No. 26, which was selected as an average tree for comparison. In general, the shoots were ready for budding three to five months after they commenced to develop.

Table II.

Production of Watershoots from 105 Trees Felled at Temerloh, Pahang.

	Period after felling (weeks).					
	3	5	7	9	11	13
No. of stumps with watershoots	36	53	96	99	100	100
Average length of all shoots (cms.)	20.4	22.2	24.6	31.4	40.3	46.5
Length of shoots from Tree No. 26 (cms.)	8	15	28	36	59	78

One watershoot from each stump was budded, cut back to ½ in. above the bud and the bud allowed to develop, before the second watershoot was budded (Fig. 15).

The first 105 buddings gave 103 successful unions (98 per cent.). Seven weeks after budding, some of the buds had grown to a height of 12 ins. (Fig. 16).

It is too soon to be certain of the success of this attempt to convert old Trinitario cacao trees into an Amelonado seed garden. The results, so far, are most encouraging. There will, however, be a need for very frequent pruning of the shoots which are certain to develop from the old rootstocks.

Production of Budwood.

It should be noted that all these results have been obtained with "chupon" buds. Comparable results on a much smaller scale have been obtained with "fan" buds.

The management of budwood areas for maximum production requires further investigation. After a stock in a budwood area has been budded with a chupon bud, a single, upright stem normally develops and reaches 3 to 5 ft. before jorquetting. When the budwood is collected it is not possible to utilise the full length of this stem as it is found that if the stem is cut right back the stock often dies. At least 1 ft. of the stem must be left carrying leaves. In order to increase production of budwood, the first upright stem of a few plants in the budwood area has been bent over and the top pegged to the ground. This has stimulated the production of several upright stems in the region of the bend. It is hoped that it will be possible to cut these secondary stems right back without damage to the rootstock.

Budwood being prepared for despatch is waxed at each end and packed in boxes with moist coconut fibre or sawdust. It will retain its viability for two or three days and probably considerably longer.

Summary.

There is an acute shortage of good cacao planting material in Malaya. Amelonado cacao is considered the most suitable type for immediate multiplication. Until seed supplies are available the most rapid multiplication can be achieved by buddings or single-leaf cuttings. Both methods are being used, but the budding technique has been found more satisfactory and better adapted to local conditions. Under good conditions, 90 per cent. unions and about 80 per cent. final successes can be obtained. The budding techniques used and some results obtained are described.

Acknowledgements.

These notes cover results obtained not only at the Federal Experiment Station, Serdang, but also on Agricultural Stations in Malacca, Perak, Pahang, Penang and Province Wellesley. The willing co-operation of the officers in charge of these Stations is gratefully acknowledged.

The encouragement, guidance and helpful criticisms of the Director of Agriculture, the Chief Research Officer, Chief Field Officer, and the Senior Agronomist are also gratefully acknowledged.

Thanks are also due to the numerous junior officers of the Department of Agriculture who have been directly responsible for much of the work discussed.

References.

1. THOMPSON, A. The Introduction of Amelonado Cocoa from the Gold Coast to Malaya. *Malayan Agricultural Journal*, Vol. 33, October, 1950.

2. COPE, F. W. Some Results of the Cacao Clonal Trials at River Estate, Trinidad. A paper presented at the Cocoa Conference, London, 1949.

3. KEEPING, G. S. The Vegetative Propagation of Cocoa. *Malayan Agricultural Journal*, Vol. 33, January, 1950.

PHOTOPERIODISM OF *ORYZA SATIVA* IN MALAYA

Experiments on the effects of a Small Difference of Light Period on Flowering of the Padi Plant

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Introduction.

In the course of several years' study of the results of padi varietal trials at padi experiment and test stations throughout Malaya prior to 1938, the writer came to the conclusion that padi grown during the north-east monsoon season (September to February) required, in the south of the peninsula, a longer period from sowing to maturation than similar varieties grown in the north; and that this difference in maturation periods for the same varieties grown in different parts of the country was not wholly due to differences in efficiency of supply and control of water.

Preliminary Observations.

During the 1938-39 season, observations were made on certain varieties growing at each of a number of padi stations, but there were too many variables in field conditions to be able to make any precise deductions regarding correlation of dates of maturation with latitude.

An attempt was then made in the 1939-40 season to examine this possible correlation with a standardised test of padi varieties at a number of padi stations from north to south of the peninsula. This standard test was comprised of five varieties of padi which were given the same nursery treatment at each padi station, with the same dates of sowing and transplanting. In an attempt to standardise water control for this experiment at each of several padi stations, the seedlings were transplanted into kerosene tins sunk nearly level with the padi fields and regularly supplied with water.

It was popularly believed that there was need for varietal acclimatisation in a new environment, which the writer could not deny, on account of experiences of varietal eccentricities at different padi stations and the observed behaviours of introduced varieties, which apparently carried some effects of original environment in the seed. In a particular instance, the need for refrigeration to induce germination of the second generation seed was recorded for a variety of Nanking rice introduced from China in 1936.

The conditions of the test required, therefore, that care should be taken to use seed at each padi station which was obtained from crops grown there the previous season. In some padi stations, alternative selected strains of each of Mayang Ebos, Reyong and Radin Siak with

histories of identical lengths of maturation periods were preferred to single standard strains where this condition could not have been fulfilled. It was believed, moreover, that old-established pure line selections would be very unlikely to express more than quite insignificant genetic variations when grown only one season away from the common seed multiplication station.

Dates of sowing were fixed for each variety, with transplanting to take place after 50 days, as follows:—

Table I.

Dates of Sowing and Transplanting.

Variety.	Date of Sowing.	Date of Transplanting.
Seraup 48	2.7.39	20.8.39
Siam 29	20.7.39	8.9.39
Mayang Ebos 80, 88	20.7.39	8.9.39
Reyong 6, 20	7.8.39	26.9.39
Radin Siak 24, 34	14.8.39	3.10.39

The date of flowering to be recorded was that of the second ear on each plant. Primary tillers were ringed early with coloured wool to facilitate subsequent identification for reckoning dates of flowering, in case of pest damage.

Again, however, field conditions introduced so many variables that the reliability of the experiment could be questioned in respect of some of the factors involved. At two of the padi stations, drought and pest damage completely upset results and these were discarded. At the remaining eight padi stations, four instances of wrong seed and one of over-shading by trees necessitated the discarding also of individual varieties in three of the series of latitude replications (Table II).

Nevertheless, the majority of the tests produced results, and these agreed in very large measure with the original observations and hypotheses.

There was much criticism of these experiments, and much doubt expressed as to the validity of the opinion that such short differences in lengths of daylight as those occuring at different latitudes in Malaya could appreciably affect the maturation periods of padi.

It was then agreed that specific tests should be conducted in Kuala Lumpur with padi grown in normal daylight, and under conditions of artificially altered length of daylight, before any further work was done in the field.

TABLE II.
Maturation Periods at Different Latitudes.

Padi Stations.	Latitude.	Maturation periods (days) —transplanting to flowering.				
		Seraup 48	Siam 29	Mayang Ebos 80, 88	Reyong 20	Radin Siak 24, 34
Kota Bharu, Kelantan	6°08′N	112	86	92	91 (Reyong 6)	88
Telok Chengai, Kedah	6°05′N	122	89	96	—	85
Talang, Perak	4°45′N	125	103	99	82	82
Sungei Manik, Perak	4°05′N	132	99	110	88	84
Dong, Pahang	3°55′N	—	97	—	84	100
Kuang, Selangor	3°15′N	—	105	104	87	—
Ampang Tinggi, N. Sembilan	2°45′N	134	103	106	98	98
Tangkak, Johore	2°16′N	139	129	120	92	93

Variation in Lengths of Day in Malaya.

It was first of all desirable to have a precise understanding of the variations in lengths of day from north to south of the Malay peninsula, and a table of sunrise and sunset times for Singapore, Kuala Lumpur, and Alor Star in Kedah was obtained from the Director, Malayan Meteorological Service (Table III).

Table IV gives a summary of this information for the second half of the year relevant to the period of the experiment, and shows the differences in range of daylengths, and the maximum and minimum lengths of day. The difference between maximum and minimum lengths of day at Singapore is only 9 minutes, at Kuala Lumpur it is 20 minutes, and at Alor Star it is 37 minutes. It may also be seen that the date of the second 12 hours day of the year is the 18th November at Singapore, the 15th October at Kuala Lumpur, and the 7th October at Alor Star in the north.

It must be remembered, of course, that precise times of sunrise and sunset can be modified by the topography of the locality, but in most large rice growing areas there is relative absence of hills.

TABLE III.

Approximate Times of Sunrise and Sunset at Singapore, Kuala Lumpur and Alor Star.

Date.	Singapore 1°18′N		Kuala Lumpur 3°08′N		Alor Star 6°09′N	
	Sunrise.	Sunset.	Sunrise.	Sunset.	Sunrise.	Sunset.
June 1	6.28	6.36	6.34	6.48	6.35	6.57
„ 15	6.30	6.39	6.36	6.50	6.37	7.00
July 1	6.34	6.42	6.40	6.54	6.41	7.04
„ 15	6.36	6.45	6.42	6.56	6.43	7.05
Aug. 1	6.37	6.44	6.43	6.55	6.45	7.04
„ 15	6.36	6.42	6.42	6.52	6.46	7.01
Sept. 1	6.32	6.38	6.39	6.47	6.43	6.54
„ 15	6.28	6.32	6.36	6.42	6.41	6.47
Oct. 1	6.22	6.26	6.32	6.34	6.38	6.40
„ 15	6.20	6.22	6.29	6.29	6.36	6.34
Nov. 1	6.18	6.19	6.28	6.26	6.36	6.29
„ 15	6.19	6.20	6.30	6.26	6.39	6.28
Dec. 1	6.24	6.23	6.35	6.29	6.45	6.31
„ 15	6.30	6.29	6.41	6.35	6.51	6.36
Jan. 1	6.38	6.38	6.50	6.44	7.00	6.45
„ 15	6.44	6.44	6.56	6.50	7.05	6.52
Feb. 1	6.48	6.49	6.59	6.55	7.07	6.58
„ 15	6.48	6.49	6.58	6.56	7.06	6.59
Mar. 1	6.46	6.48	6.56	6.56	7.02	7.00
„ 15	6.42	6.46	6.50	6.54	6.57	6.59
Apr. 1	6.36	6.41	6.44	6.50	6.49	6.56
„ 15	6.32	6.38	6.39	6.47	6.45	6.55
May 1	6.28	6.35	6.35	6.45	6.38	6.53
„ 15	6.27	6.34	6.33	6.45	6.35	6.54

N.B. Malayan Standard Time (G.M.T. + 7½ hrs.)

General Discussion.

Most plants are dependent on sunlight for the energy necessary in manufacture of carbohydrate food material, but most plants also require some periods of darkness to complete the cycle of their life history. Furthermore, although some plants are relatively insensitive to fairly considerable differences in lengths of alternating daylight and darkness periods, sensitivities are such that species have been divided into two groups—"long-day" plants which require relatively long days to reach sexual maturity, and "short-day" plants which require long nights for causation of flowering after a period of vegetative growth.

Temperature effects are known to be complementary to photoperiods, but any possible comparative effects of high and low temperatures do not need consideration in this present study on account of the uniformity in Malaya of this factor throughout the year, as shown in Table V which gives the air temperatures recorded at various meteorological stations throughout the peninsula.

Table IV.

Differences in Periods of Daylight.

Date.	Sunrise and Sunset		Sunrise to Sunset.	
SINGAPORE	a.m.	p.m.		
1st July	6.34	6.42	12 hrs. 8 mins.	(max.)
1st Aug.	6.37	6.44	12 „ 7 „	
1st Sept.	6.32	6.38	12 „ 6 „	
1st Oct.	6.22	6.26	12 „ 4 „	
1st Nov.	6.18	6.19	12 „ 1 „	
18th Nov.	6.21	6.21	12 „ 0 „	
1st Dec.	6.24	6.23	11 „ 59 „	(min.)
KUALA LUMPUR				
1st July	6.40	6.54	12 „ 14 „	(max.)
1st Aug.	6.43	6.55	12 „ 12 „	
1st Sept.	6.39	6.47	12 „ 8 „	
1st Oct.	6.32	6.34	12 „ 2 „	
15th Oct.	6.29	6.29	12 „ 0 „	
1st Nov.	6.28	6.26	11 „ 58 „	
1st Dec.	6.35	6.29	11 „ 54 „	(min.)
ALOR STAR				
1st July	6.41	7.04	12 „ 23 „	(max.)
1st Aug.	6.45	7.04	12 „ 19 „	
1st Sept.	6.43	6.54	12 „ 11 „	
1st Oct.	6.38	6.40	12 „ 2 „	
7th Oct.	6.37	6.37	12 „ 0 „	
1st Nov.	6.36	6.29	11 „ 53 „	
1st Dec.	6.45	6.31	11 „ 46 „	(min.)

N.B. Malayan Standard Time (G.M.T. + 7½ hrs.)

Table V.

Air Temperatures, Malaya.

	Mean maximum.	Mean minimum.
Alor Star, Kedah	86 - 92°F	71 - 76°F
Kota Bharu, Kelantan	84 - 90°F	71 - 75°F
Butterworth, P. Wellesley	86.5 - 89.5°F	73 - 75°F
Kuala Lumpur	89 - 93°F	71.5 - 73°F
Malacca	85 - 89°F	73 - 75°F
Kluang, Johore	85 - 90°F	70 - 73°F
Singapore	85 - 89°F	74.5 - 78°F

By reason of successful maturation in its normal autumn season, rice is known as a so-called "short-day" plant, requiring a relatively short day (long night) for development of the inflorescence.

The majority of rice varieties in Malaya are typical "short-day" plants, flowering and cropping successfully only in the shorter days of October to February or March, evidently requiring the shorter day-longer night conditions of the autumn months in Malaya for development and exsertion of their ears. These varieties are often known as "season-fixed" varieties for this reason of always maturing at a certain season of the year.

The lengths of maturation periods of these varieties, too, are very considerably affected by the date of sowing, and experience has shown that when grown "out-of-season", although the plants may be well grown and past their usual length of time for maturation, they do not flower during the months of longer days, i.e. approximately from May to August.

These varieties are therefore presumably sensitive even to the relatively very small changes in lengths of day which occur at these low latitudes, and it is reasonable to suppose that there must be certain, more or less precise, daily durations of light which define, varietally, the difference between the continuation of vegetative growth and the onset of flowering. It is probable that high tropical temperatures accentuate photoperiod sensitivities at low latitudes, but this has not been determined.

As has been shown in Tables III and IV, the length of time between sunrise and sunset in Malaya never departs very far from 12 hours; therefore, the "critical" photoperiod, at least for the usual November-to-February-maturing, " season-fixed ", varieties of padi, must be very close to this period of 12 hours, plus the relevant periods of effective light at dawn and evening twilight—whatever these may prove to be.

It is also, however, evident from experience, that there are some Malayan rice varieties in which flowering is uninhibited by the longest length of day in Malaya, and which can produce, if not damaged by pests, substantial "out-of-season" crops.

The maturation periods of a few of these uninhibited or "insensitive" varieties are quite unaffected by the different lengths of day in the "off-season" in Malaya, but others, of which Radin Siak is an example, appear to be intermediate in their sensitivities to and requirements of diurnal dark-periods, for though they flower and crop successfully in the " off-season " long-day light conditions, they do so only with somewhat extended maturation periods.

Several of these locally uninhibited, or photoperiod insensitive, varieties have, however, failed to flower, during the long day summer season, when grown in trials in other countries at higher latitudes, and it seems possible that with these Malayan "uninhibited" varieties, induction of flowering can be inhibited by a photoperiod somewhat longer than occurs naturally at this latitude.

It is also possible that a full survey of rice varieties and photoperiod sensitivities should reveal that "light period insensitivity" is a

relative term, and that all varieties could best be distinguished by the index of their respective "critical" or optimum photoperiods.

Effects of Altered Photoperiod.

As a result of the field observations described above, and the subsequent criticisms, in 1940, an experiment was designed to test, under controlled conditions in Kuala Lumpur, the effects of small changes in lengths of daylight periods on maturation of padi. Three widely grown varieties of padi were chosen, to be given extra illumination to maintain total light periods of over 12 hrs. 30 mins., normal daylight, and reduced daylight periods of below 12 hrs., both in the nursery and after transplanting. Each treatment was to be continuous, the three later treatments being superimposed on the others at transplanting, so that each variety would, in fact, receive nine variations of light period treatments.

Table VI.

Photoperiod Experiment Plan.

Variety.	Comparable maturation period—sowing to harvest.	TREATMENTS.	
		Nursery period 24th June to 24th Aug.	After transplanting.
Seraup 48	7½ months	(i) extra illumination	(a) extra illumination
Siam 29	6¾ months	(ii) normal daylight	(b) normal daylight
Reyong 20	6½ months	(iii) reduced daylight	(c) reduced daylight

A part, 14 x 30 ft., of the padi breeding cage was screened off, and twelve 100 watt electric light bulbs—gas-filled, tungsten filament lamps of 185 c.p.—were installed with a time-switch control. These electric light bulbs were fixed at a height of 4 ft. from the tops of the earthenware tubs, and subsequently 9 ins. above the tops of the fully grown padi plants.

Dark covers were made for the reduced light treatment of the seedlings nurseries, but it was found impossible conveniently and inexpensively to arrange for the reduced light treatment over the much larger area required after transplanting, and this was omitted.

The padi was grown in typical padi-land soil in large earthenware tubs, and with controlled running water supply. Seed was sown on the 24th June and two intermediate transplantings were made on the 15th July and the 3rd August to ensure that no crowding during the protracted time in the nurseries could affect the seedlings. The padi seedlings were finally planted out in 52 tubs, three seedlings to a tub, on the 24th August, 1941, in the two series of extra illumination and normal daylight treatments.

Table VII.

Times and Periods of Treatments.

Date.	Kuala Lumpur Sunrise a.m.	Sunset p.m.	Official daylight.	Estimated times. Dawn + 13 mins. a.m.	Dusk + 18 mins. p.m.	Average maximum total dayight.	Extra illumination by electric light.	Total periods of illumination.	Reduced daylight —screened at 6.30
June 24th	6.38	6.52	12 hrs. 14 mins.	6.25	7.10	12 hrs. 45 mins.	till 7.20 p.m. + 10 mins.	12 hrs. 55 mins.	12 hrs. 5 mins.
July 1st	6.40	6.54	12 „ 14 „	6.27	7.12	12 „ 45 „	„ 7.20 p.m. + 8 mins.	12 „ 53 „	12 „ 3 „
August 1st	6.43	6.55	12 „ 12 „	6.30	7.13	12 „ 43 „	„ 7.20 p.m. + 7 mins.	12 „ 50 „	12 „ 0 „
September 1st	6.39	6.47	12 „ 8 „	6.26	7.05	12 „ 39 „	„ 7.20 p.m. + 15 mins.	12 „ 54 „	
October 1st	6.32	6.34	12 „ 2 „	6.19	6.52	12 „ 33 „	„ 7.10 p.m. + 18 mins.	12 „ 51 „	
October 15th	6.29	6.29	12 „ 0 „	6.16	6.47	12 „ 31 „	„ 7.10 p.m. + 23 mins.	12 „ 54 „	
November 1st	6.28	6.26	11 „ 58 „	6.15	6.44	12 „ 29 „	„ 7.10 p.m. + 26 mins.	12 „ 55 „	
December 1st	6.35	6.29	11 „ 54 „	6.22	6.47	12 „ 25 „	„ 7.10 p.m. + 23 mins.	12 „ 48 „	
December 15th	6.46	6.40	11 „ 54 „	6.33	6.58	12 „ 25 „	„ 7.10 p.m. + 12 mins.	12 „ 37 „	
January 1st	6.50	6.44	11 „ 54 „	6.37	7.02	12 „ 25 „	—	12 „ 25 „	

N.B. All times are corrected to Malayan Standard Time (G.M.T. + 7½ hrs.)

As stated above, the extra illumination was designed to maintain a total light period of just over 12 hrs. 30 mins. and the reduced light treatment to reduce the daylight period to below 12 hrs. Before sunrise and after sunset light was, however, overlooked in this calculation, and with the addition of the period of light before sunrise, most of the totals of the extra illumination periods just exceeded 12 hrs. 50 mins. Table VII conveniently shows the times and periods of applications of the different treatments.

The experiment provided interesting comparisons early in December, 1941, for by then some (Reyong 20) of the padi plants, which since transplanting had received normal daylight only, were showing signs of developing ears, while the plants which were being given extra illumination were showing no signs of inflorescence development, but were somewhat stronger in growth and darker green in colour.

Reyong 20, in the normal daylight series, completed flowering by the 24th November (91 days after transplanting), and Siam 29 by the 2nd December (100 days after transplanting).

The outbreak of war in Malaya then intervened and the writer was mobilised with the Volunteer Armoured Car Regiment. He was, however, in the vicinity of the experiment on the 25th December, 1941, and the 8th January, 1942, and was able to make further observations.

In the normal daylight series, Seraup 48 had just completed flowering by the 25th December, 1941, and Reyong 20 had ripened. By the 8th January, 1942, Reyong 20 was over-ripe and had fallen about the pots, Siam 29 was just fully ripened, and Seraup 48 was carrying a good crop of maturing grain.

With reference to the plants that were given extra illumination, it is understood that the automatic light switch had been left on for at least a week after the outbreak of war so that the plants continued to receive extra illumination, and the experiment was continued as designed until about the middle of December.

This is understandable, as the padi experiments "cage" was at the back of the Department of Agriculture buildings and the lights were well screened above, and were "on" for such a short while after dusk, that they were not immediately noticed, and turned off.

The plants with this extra light treatment were of dark green colour and particularly vigorous in vegetative growth, both in height and in number of tillers, but there was no flowering, nor any external evidence of its approach.

Dissections of young inflorescence shoots were made, but it was not possible to do them in great detail, nor were the results properly recorded.

As stated above, the lights were switched off on or about the 15th December, 1941. On the 25th December, there was one flowering ear of Siam 29 and by the 8th January, 1942, several ears on each plant of the three varieties of padi were making their appearance.

Table VIII.

Photoperiod Experiment Results.

Variety.	Light Treatments.		Date of completion of flowering.	Date of ripened grains.
	In the Nursery 24th June-24th August.	After transplanting on 24.8.41.		
Reyong 20	Normal	Normal	24.11.41	25.12.41
Siam 29	„	„	1.12.41	8. 1.42
Seraup 48	„	„	25.12.41	(a)
Reyong 20	Extra	Normal	24.11.41	25.12.41
Siam 29	„	„	1.12.41	8. 1.42
Seraup 48	„	„	25.12.41	(a)
Reyong 20	Reduced	Normal	24.11.41	25.12.41
Siam 29	„	„	2.12.41	8. 1.42
Seraup 48	„	„	25.12.41	(a)
Reyong 20	Normal	Extra	(b)	—
Siam 29	„	„	(b) (c)	—
Seraup 48	„	„	(b)	—
Reyong 20	Extra	Extra	(b)	—
Siam 29	„	„	(b)	—
Seraup 48	„	„	(b)	—
Reyong 20	Reduced	Extra	(b)	—
Siam 29	„	„	(b)	—
Seraup 48	„	„	(b)	—

(a) a full crop of grain was ripening on the 8th January, 1942.
(b) flowering only after cessation of extra illumination.
(c) one ear noted on the 25th December, 1941.

In the extra illumination treatments, as may be seen from Table VII. it was only after a reduction of light to below a total period of about 12 hrs. 37 mins. that the five varieties of rice flowered. It is possible that most local rice varieties may have a "critical" daily photoperiod close to this length of time. The dates of flowering in normal daylight do not disagree with this hypothesis.

The short interval of time between the date when extra illumination ceased and the date when the padi plants commenced to flower suggests that spikelet primordia were already differentiated in the embryonic inflorescence, which only awaited the required light conditions to commence growth and full development.

It may be of some interest to note that the treatment with reduced light applied during the nursery period had no effect of inducing early flowering. It is possible that a period of vegetative growth is required before a relatively long period of diurnal darkness or night can produce the effect necessary for flowering development.

Dawn and Evening Light Values.

As the experiment proceeded, it was realised that the measurement of daylight periods by the intervals between official times of sunrise and sunset was unsatisfactory in assessing periods of effective light. It was not correct to overlook the periods of evening and morning light, especially in view of the fact that very low light intensities have been known to affect photoperiod responses in some experiments.

It was not possible to make suitable light measurements before the interference of the war for lack of a suitable light meter, and it was not until March, 1948, that measurements of these low light intensities before sunrise and after sunset were made. These were made at an unshaded position, near the Department of Agriculture, Kuala Lumpur, daily, for several weeks, with a simple illumination meter lent by the General Electric Company, Kuala Lumpur,—the only meter available at the time.

Light intensities varied greatly according to weather and according to positions and densities of clouds and mist at sunrise and sunset. The maximum length of time at morning before sunrise during which there was measurable light value of at least 1 f.c. was about 20 mins., while the maximum period at evening after sunset was 22 mins.

The minimum periods in these respective circumstances were 7 mins. in the morning and 12 mins. in the evening; while the mean length of the measurable light periods in the morning was 12 mins.; and in the evening was 18 mins.

The mean value of light at sunrise over 20 days was, however, more than 40 f.c., while the mean value at sunset over 18 days was only 28 f.c. In general, therefore, light values for the 10 mins. before sunrise were greater than for the 10 mins. after sunset.

Photosynthesis must be related, to some extent, with any effects of light, but it can hardly be the basis of the whole of the effects of photoperiods because of the results recorded of the effects of very low light values in various relevant experiments.

The respective effective light values are not known, so that apart altogether from the difficulties pertaining to considerable variations in dawn and twilight periods and light values, it is impossible without much further investigation to correlate these periods of early morning and evening light with daily photoperiods.

It is possible, however, that the official lengths of daylight in Malaya should be increased by 20 to 30 mins. for any consideration of photoperiodism.

Conclusions.

It has been shown that short periods of extra illumination, consecutive with daylight, which maintained a daily light period of more than 12 hours 30 minutes inhibit or very greatly delay inflorescence development in three typical and widely grown varieties of Malayan padi.

Approximate Light Intensities in F.C. at Sunrise, Kenny Road, Kuala Lumpur, March, 1948.

A.M.	29/2	1/3	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
	Overcast, rain	Rain	Slight haze	Fine, clear	Foggy	Fine, clear						Fine	Bright	One heavy cloud in E.	Fine, dull	Clouds and haze		Foggy	Light rain	Bright	Cloudy	Fine	High clouds	Slight haze	Haze	Very foggy	
6.30													1							1			1				
.32												1	3							1			2	1			
.34						1						3	5							3		1	3	2			
.36				1		2						5	8							5		2	4	3	1	1	
.38			1	2	1	3						8	11							8	1	3	5	4	2	2	
.40		1	2	3	2	4						12	18	1	1	1		1		12	3	7	11	10	3	3	
.42		2	4	5	4	6	←	On	Tour	→		21	28	2	2	2		2	1	20	6	12	17	15	6	5	
.44		3	6	7	7	9						30	38	10	9	7		3		30	9	18	24	24	12	9	
.46		5	11	15	12	17						38	46	25	24	17		7	2	36	13	26	36	34	20	13	
.48	1	8	14	20	18	26						46	> 50	33	32	26		17		45	18	36	50	47	29	17	
.50	1	11	22	41	24	38						> 50		43	42	36		29	3	> 50	25	47		> 50	38	26	
.52	3	19	31	> 50	32	> 50								> 50	> 50	48		35	4			> 50			> 50	36	
.54	5	23	43		41											> 50		40	6							49	
.56	7	35	> 50		50													44	11							> 50	
.58	9	45																49	15								
7.00	13	> 50																> 50	22								
.02	19																		30								
.04	24																		37								
.06	32																		46								
.08	37																		> 50								
.10	45																										
.12	> 50																										

On Tour Locally.

Times of Sunrise: 6.56 a.m. on 1.3.48 and 6.46 a.m. on 1.4.48.

Approximate Light Intensities in F.C. at Sunset, Kenny Road, Kuala Lumpur. March, 1948.

P.M.	29/2	1/3	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
	Rain	Heavy rain	Cloudy	Fine	Light clouds	Fine						Haze	Bright	Haze	Heavy clouds in W.	Rain	Fine clear	Fine after rain	Clearing after rain	Cloudy	Cloudy	Cloudy	Fine	High cumulus	High cumulus	
6.40		43													38												
.42		36													31					> 50							
.44	> 50	30	> 50												26			> 50	> 50	48		> 50				
.46	47	25	48												18			42	46	45		44		> 50		
.48	42	23	43		> 50	←		On Tour		→				> 50	14			37	42	41	50	39	> 50	42	50		
.50	38	21	39	> 50	46							> 50		44	12	On Tour Locally.	50	32	38	37	45	33	41	32	39		
.52	34	19	32	43	30							49		32	10		34	27	34	32	33	28	32	26	31		
.54	30	17	26	31	20							32		19	7		25	21	29	28	27	22	26	21	24		
.56	24	15	21	23	14							23	> 50	13	5		19	17	25	25	20	18	19	18	18		
.58	20	14	16	17	9							16	30	8	4		14	13	20	21	15	14	15	13	14		
7.00	17	12	12	12	5							11	17	5	3		11	9	16	16	12	12	12	9	10		
.02	13	9	8	8	3							7	14	3	3		7	7	12	12	9	9	10	5	7		
.04	8	6	6	6	2							5	9	2	2		4	5	9	9	7	7	8	4	5		
.06	6	4	4	4	1							3	5	1	1		2	4	7	6	5	5	5	3	4		
.08	4	3	3	3	1							2	3	1	1		1	3	5	4	4	3	4	2	3		
.10	3	2	2	2								1	2				1	2	3	3	3	2	3	1	2		
.12	2	2	1	1									1					1	2	2	2	1	2		1		
.14	1	1																	1	1	1		1				

Times of Sunset: 6.56 p.m. on 1.3.48 and 6.50 p.m. on 1.4.48.

It was also observed that flowering commenced within only three weeks of the cessation of the supplementary illumination and the introduction of "long" night. It is possible, therefore, that the flower primordia were already formed and that the light period reduction was responsible for inducing growth and development of the inflorescence but not the initiation of the flowers.

Examination of the figures relating to daily periods of direct sunlight show that at Alor Star (latitude 6°.09′N), during the usual padi season, daylight periods between sunrise and sunset remain above 12 hrs. until the 7th October; at Kuala Lumpur (latitude 3°.08′N) until the 15th October, and at Singapore (latitude 1°.18′N) until the 18th November, and it seems possible, in view of the results of the experiment here described, that such small differences in dates of the change to "short" days do affect the dates at which some varieties of padi will flower and form grain.

Different behaviour in this respect may be expected from north to south of the peninsula, by reason of the later occurrence of "short" days at lower latitudes.

It was also shown that approximately 40 minutes reduction of normal light periods for rice seedlings up to two months old had no effect on the onset of flowering of the mature plants subsequently grown in normal daylight.

It was demonstrated that the rice plants grown with short, additional daily periods of illumination had made more growth, had more tillers and were of deeper green colour than the plants grown in normal daylight. Whether this was due to the extra daily periods of light or due to continuing vegetative vigour as such, was not determined.

A brief discussion is included on the variations and possible effects of low light intensities before sunrise and after sunset.

Acknowledgements.

I have to acknowledge with thanks much data on local daylight periods supplied by the Director, Malayan Meteorological Service; the loan of a photometer by the Manager, General Electric Company, Kuala Lumpur; and, in 1938, the assistance of Dr. P. S. Hudson, Director of the Commonwealth Agricultural Bureau of Plant Breeding and Genetics at Cambridge, with references to relevant literature.

Relevant Literature.

1. FERNANDO DE PERALTA, 1918 .... "A study of the Relation of Climatic Conditions to the Vegetative Growth and Production of Rice." The Philippine Agric. 7, No. 6, pp. 159-179.

2. GARNER, W. W. and ALLARD, H. A., 1920 .... "The effect of relative length of day and night and other factors of the environment on growth and reproduction in plants." Journal Agric. Research, 18, 11, pp. 553-606.

3. KUILMAN, L. W., 1937 "Photoperiodiciteit bij rijst." Landbouw, 13, pp. 22-36.

4. DUGGAR, B. M., 1937 .... "Biological Effects of Radiation" Vol. II—McGraw-Hill Book Co., 1937.

5. RHIND, D., 1935 .... "A note on photoperiodism in Sesamum." Journ. Ind. Agric. Sci., 5, pp. 729-736.

6. MCCLELLAND, T. B., 1924 "The photoperiodism of *Tephrosia candida*." Journ. Agric. Research, 28, 5, pp. 445-460.

7. - do - 1928 .... "Studies of the photoperiodism of some economic plants." Journ. Agric. Research, 37, pp. 603-628.

8. TINCKER, M. A. H., 1925 "The effect of length of day upon growth and reproduction of some economic plants." Ann. Bot., 39, pp. 721-754.

9. LORD, L. & DE SILVA, J. S. T., 1931 .... "A note on the effect of sowing date on the age of Maha padi." Trop. Agriculturist, 76, June, pp. 332-333.

10. HAIGH, J. C., 1936 .... "A note on the effect of sowing date on age of padi." Trop Agriculturist, 86, May, pp. 284-288.

11. CARTON, P., 1934 .... "Considerations sur 1'action de la lumiere sur les plantes." Bull. Gen. de 1' Instruction Publique, Hanoi.

12. ARAGON, V. B. and CODA, E., 1939 .... "A preliminary report on the performance of ten rice varieties from F.M.S." The Philippine Agric. 27, 8, pp. 635-646.

13. SCRIPCHINSKY, B., 1940 "The factor which stimulates to develop the rice into flowering under tropical conditions." Trop. Agriculturist, 95, 10, pp. 205-211.

14. CHANDRARATNA, M. F., 1948 .... "The effect of day length on heading time in rice." Trop. Agriculturist, 104, 3, pp. 130-140.

15. ADAIR, C. R., 1940 .... "Effect of time of seeding on yield milling quality and other characters in rice." Journ. Amer. Soc. Agron., 32, pp. 697-706.

16. COYAND, Y. P., 1948 .... "Notes sur la dureé d'évolution des variétiés de riz cultivees en Indo Chine." Agron. Trop., 3, 5/6.

17. BENSON, E. G., and MURRAY, D. B., 1948 .... "A note on the effect of continuous light on the flowering of padi." Trop. Agriculture, 25, p. 3.

18. MISRA, G., 1951 .... "Photoperiodic response in some early varieties of padi." Current Science, 20, 8, p. 209.

19. KUILMAN, L. W., 1940 "Tillering and flowering in the rice plant." Med. Alg. Prof. V. D. Landbouw Bull. 45.

20. ALLARD, H. A., 1932 .... "Length of day in relation to the natural and artificial distribution of plants." Ecology, 13, 3, pp. 221-234.

21. GARNER, W. W., 1933 .... "Comparative responses of long-day and short-day plants to relative lengths of day and night." Plant Physiology, 8, 3, pp. 347-356.

22. EVANS, M. W., 1931 .... "Relation of latitude to time of blooming of timothy." Ecology, 12, pp. 182-187.

23. - do - 1939 .... "Relation of latitude to certain phases of the growth of timothy." Amer. Journ. Bot., 26, 4, pp. 212-218.

24. EVANS, M. W. and ALLARD, H. A., 1934 .... "Relation of length of day to growth of timothy." Journ. Agric. Research, 48, pp. 571-586.

25. EVANS, M. W., ALLARD, H. A. and MCCONKEY, O., 1935 .... "Time of heading and flowering of early medium, and late timothy plants at different latitudes." Scientific Agric., 15, 7, pp. 573-579.

26. PURVIS, O. N. and GREGORY, F. G., 1937 .... "Studies in vernalisation of cereals." Ann, Bot. N.S., 1, 4, pp. 569-591.

27. ROBERTS, R. H. and STRUCKMEYER, B. E., 1938 .... "The effects of temperature and other environmental factors upon the photoperiodic responses of some of the higher plants." Journ. Agric. Research, 56, 9, pp. 633-677.

28. WHYTE, R. O., 1939 .... "Phasic Development of Plants" Biol. Revs., 14, pp. 51-87.

29. HERBAGE REVIEWS, 1940 "Photoperiodic aspects of phasic development." Herbage Reviews, 8, 4, pp. 196-198.

30. GALINAT, W. C. and NAYLOR, A. W., 1951 .... "Relation of photoperiod to inflorescence proliferation in Zea Mays. L." Amer. Jour. Bot., 38, 1, p. 38.

31. BORTHWICK, H. A. and PARKER, M. W., 1938 .... "Photoperiodic perception in Biloni Soyabeans." Bot. Gazette, 100, pp. 374-387.

32. LONG, E. M., 1939 .... "Photoperiodic induction as influenced by environmental factors." Bot. Gazette, 101, pp. 168-188.

33. LARSEN, E. C., 1947 .... "Photoperiodic responses of geographical strains of *Andropogon scoparius*." Bot. Gazette, 109, 2, pp. 132-149.

34. GOODALL, D. W., 1937 .... "Further observations on factors affecting the position of the first inflorescence in the tomato." Cheshunt Expt. Res. Stn. Ann. Rep. 23.

35. LOEHWING, W. F., 1939 "Photoperiodic aspects of phasic development." Science, 90, No. 2344, pp. 552-555.

36. HAMNER, K. C., 1938 .... "Correlative effects of environment.—Factors on photoperiodism." Bot. Gazette, 99, March, pp. 615-629.

37. GRAINGER, J., 1938 .... "Studies upon the time of flowering of plants." Ann. Appl. Biol, 25, pp. 1-19.

38. SNYDER, W. E., 1940 .... "Effects of light and temperature on floral initiation in Cockleburr and Biloni soyabean." Bot. Gazette, 102, pp. 302-322.

39. MANN, L. K., 1940 .... "Effect of some environmental factors on floral initiation in Xanthium." Bot. Gazette, 102, pp. 339-356.

40. WHYTE, R. O., 1946 .... "Crop production and environment." Faber & Faber, London.

41. MURNEEK, A. E. and WHYTE, R. O., 1948 .... "Vernalisation & Photoperiodism." Chronica Botanica Co., Waltham, Mass.

42. GREGORY, F. G., 1948 .... "The control of flowering in plants." Symposia Soc. Exptl. Biol. No. 2, Cambridge, 1948. (Herbage Extracts, 19, 1949, p. 250.)

43. COOPER, J. P., 1950 .... "Day-length and head formation in the rye-grasses." Journ. Br. Grassland Soc., 5, pp. 105-112.

44. - do - 1951 .... "Studies of growth and development in Lolium." II "Pattern of bud development." Journ. of Ecology, 30, 2.

45. I.A.B., 1935 .... "Vernalisation & Phasic Development of plants." Imp. Agri. Bureaux Bull. No. 1.

MECHANISATION

Half-yearly Progress Report, October, 1951 to March, 1952.

Compiled by the Senior Agronomist and Agricultural Engineer.

Recent Importations.

The following tractors and implements were received recently:—

David Brown Trackmaster '30' tractor.
Field Marshall Series 3 tractor.
Dempster seed drill for Ferguson tractor.
Allman Plantector sprayer.
Allman Midget knapsack dusters.
Dyna-Fog insecticidal fog generator.
Tullos hand-operated thresher.

Tests and Modifications.

Preliminary Tests with a David Brown Trackmaster '30' Tractor.

The David Brown Trackmaster '30' is a 30 h.p. track-laying tractor fitted with a four-cylinder, wet-sleeved, diesel engine developing 34.5 b.h.p. at 1,800 r.p.m. Electric starting is provided. The gear box is of the three-speed-and-reverse type, and a high low transfer box is fitted, providing a range of six forward and two reverse gears. Tracks and track frames are of conventional design. The wide-gauge model supplied to the Department has 13 ins. track plates and a static ground pressure of 4.45 lbs. per sq. in.

This tractor has been run-in and given preliminary trials at the Federal Experiment Station, Serdang. Operators have found it easy and comfortable to drive, and starting has proved exceptionally simple. The two six-volt C.A.U. batteries store sufficient power for frequent starts, and the only trouble which has been experienced was a short circuit in the starter-motor windings.

In the field, the Trackmaster can easily pull a two-furrow mouldboard plough or an 8½ ft., heavy, two-gang disc-harrow.

Dempster Seed Drill.

This is a semi-mounted cereal drill designed for the Ferguson tractor. It is of sheet metal construction and is fitted with pneumatic rubber tyres. The feeding mechanism consists of fluted rollers revolving inside a casting, and very accurate control of seeding rates is possible. Seed is fed down tubes to disc-coulters which can be set to plant at any desired depth, the basic row width being 7½ ins.

The Dempster drill has been successfully used to sow Centrosema-Calopogonium mixtures at 15 lbs. per acre and sorghum at 6 lbs. per acre.

Wild 5-gang Seeder Unit.

The Wild seeder is designed for mounting on the three-point linkage of Fordson or Ferguson tractors. The five units are mounted on a special toolbar frame and can be set to almost any desired row width. Sowing rate is controlled by selecting suitably sized holes in the feed plate, and depth of planting can be varied by adjusting the coulters.

This seeder has been used to sow maize, soya beans, groundnuts and sorghum at the Federal Experiment Station, Serdang. These crops have all been drilled in 27 in. rows in order to facilitate inter-row cultivation with the Ferguson steerage hoe. Centrosema-Calopogonium mixtures have also been sown by the Wild seeder at rates of about 10 lbs. per acre.

Allman Plantector Sprayer.

The Plantector is a high/low-volume sprayer available both as a trailer machine and for direct mounting on the hydraulic-lift of various tractors. The gear-type pump, driven by the tractor power-take-off, is of large capacity and excess spraying liquid is by-passed to the 40 gallon tank giving a moderate degree of agitation. The model used by the Department is fitted with a Genimec control valve which gives excellent control of application rates and allows the booms to be used independently.

The Plantector has not, as yet, been modified for *lalang* spraying but has been reserved for low-volume spraying experiments on pasture and arable crops. It would, however, be a simple matter to remove the spray booms and fit two hand lances for sodium arsenite or aromatic oil spraying, and the Genimec control valve would be highly satisfactory when spraying sporadic *lalang*.

For low-volume spraying with hormone weed killers, the ceramic nozzles fitted to the boom have been found to give even and thorough coverage. Calibration is very simple if Allman Spraymeters are used. The spraymeter is a glass jar which clips over the spray nozzle and collects the spray; application rates per acre can then be easily calculated by a "slide rule" arrangement on the side of the jar which takes nozzle spacing and tractor speed into account.

Costing Trials with the Robinsons Midget Thresher.

The threshing trials carried out last year in the Krian District of Perak and described in the Journal for April, 1951, have been repeated. For this season's work the thresher was modified by replacing all the chain drives with Vee belts, and an Austin 10 h.p. motor was used to drive the thresher instead of a Fordson tractor.

Yields were lower than in 1951 but the cost of hand harvesting and mechanised threshing was again about 29 cents per gantang. The cost of hand harvesting and hand threshing was estimated to be much lower and it is evident that the use of this thresher was uneconomic.

NOTES ON CURRENT INVESTIGATIONS, JANUARY TO MARCH, 1952.

Compiled by the Acting Chief Research Officer and the Senior Agronomist.

Padi.

1. RESEARCH.

Variety Trials.

Most of the variety trials were reaped during the quarter, and results of the earlier reapings are coming in and being analysed. On the whole, the season has been a fairly successful one and the majority of trials are expected to give useful results. Most of the trials in Johore and some in Negri Sembilan and Pahang have failed owing to excessive pest damage resulting from lack of padi planting in the vicinity of the Padi Stations. Several trials in Kelantan and Malacca have failed owing to non-setting of seed, apparently due to climatic causes—an uncommon contingency. There have been few failures from the usual climatic causes, flood etc.

Variety Selection.

Serendah Kuning selection plots have been reaped, records received and selection continued. Some 40 lines are being retained, and the 12 most promising have been selected for variety trials in Negri Sembilan and Malacca in comparison with mass selected and unselected strains in the coming season. Of the Ampang Tinggi selections, Serendah Kuning 56 is outstanding at that Station; of the Kendong, Negri Sembilan, selections, Serendah Kuning 3 is the most promising at both Kendong and other Stations at which preliminary trials have been carried out. The foundation stock of Mayang Sa Gumpal has failed at Jelawat, Kelantan, probably as a result of water conditions, and will be regrown for a further season before selection can commence. The Anak Naga selection plot at Kota Bharu, Kelantan, has grown well and with other selection experiments is in process of being reaped and recorded.

Hybridisation.

F_1 plants of 13 crosses grown in the padi cage at Headquarters, Kuala Lumpur, have produced sufficient F_2 seed to plant approximately half an acre with reasonable germination; this will be grown at Pulau Gadong, Malacca, for selection. Hybridisation has been continued and 264 ears of 16 varieties have been pollinated, involving 71 different crosses. Seed has set in 119 of the 264 ears.

Plant Analyses for Examination of Soil Fertility.

Investigators in other countries have demonstrated that the best way to study cereal crops in connection with soil fertility is to analyse

the leaf at the flowering stage of the plant. A preliminary investigation has been started. During the quarter, a total of 74 leaf samples, taken from padi plants at this stage of growth, from Kedah, Perlis, Province Wellesley and Malacca, have been analysed. The Kedah and Perlis samples were also examined in conjunction with a general survey of plants from different parts of these two States to find out whether there is any correlation between yield of padi and composition of leaf ash.

Pest Control.

Arrangements are being made to receive from Trinidad puparia of Tachinid flies parasitic on stem-borer caterpillars. These will be mass liberated in a double-cropping padi area in Province Wellesley, as this method is more likely to establish the flies than laboratory rearing followed by small scale liberation.

Tests with certain systemic insecticides, in which padi seedlings had been soaked for 48 hours, last August, were due for harvesting in February. Unfortunately, very poor growth with more than usual bird attack made the plots useless for tiller counts of damage by stem-borers.

Summaries have been prepared from questionnaires replied to by all State and Settlement Agricultural Officers on certain padi pests. They comprise *Leptocorisa*, *Scotinophara* and padi stem borers, and show their status in the States and Settlements.

2. Agronomic Investigations.

Wet Padi.

Harvesting is in progress or has been completed in most localities and some results have been received. Statistical analysis of these results is in progress.

A large proportion of empty grain has been reported from Kelantan and Trengganu and yields are, therefore, below average. The causes of this were shortage of irrigation water during growth, *Leptocorisa* attack and wet weather during flowering. Similarly, wet weather and high winds in central Pahang have caused considerable lodging with consequent reduced yields.

In the "Type and Depth of Nitrogen" series of manurial trials, growth and yield responses from sulphate of ammonia are reported to be more marked than from nitrate of soda at all centres.

Seeding trials in Perak point to 7 gantangs per acre as being a satisfactory seed-rate for broadcast padi.

Dry Padi.

Yields in Kelantan have been reduced by the comparative failure of the monsoon.

In a "Type of Phosphate" manurial trial at Melor, Kelantan, it is reported that all types of phosphate were of equal efficiency in increasing yields. This result naturally favours the cheap Christmas Island rock phosphate, which appears to be an inefficient fertiliser for wet padi. This

same experiment indicates that a dressing of nitrogen and potash gives no benefit in increased yields in the absence of phosphate. The cheapest dressing gave a yield increase of 95 per cent. over control, the cost of fertiliser being 9 cents per lb. of extra padi produced.

A mechanisation demonstration at Melor has shown that dry padi cultivation can be completely mechanised. The land was ploughed and cultivated with tractors; seed was drilled with a tractor drawn seed-drill; fields were weeded with a steerage hoe and the crop was reaped, threshed and bagged with a combine harvester. Labour at no time exceeded three men, and two would probably have been sufficient. It was also shown that, given a reasonably clean seed bed, drilling at 7 ins. between rows with a seedrate of 80 lbs. per acre is a satisfactory substitute for hand dibbling and has the advantage that, with adequate manuring, weeding will probably not be required.

Cacao.

1. Research.

Amelonado.

The policy of rapid multiplication of Amelonado is being pursued. The approximate number of cuttings/buddings/seedlings planted in, or available for seed gardens, is:—

Jerangau Estate	357
F.E.S. Jerangau, Trengganu	260
Sungei Udang, Malacca	124
Degong, Perak	1,349
Ayer Itam, Penang. *ca*	200
Bukit Mertajam, Province Wellesley	39
F.E.S. Serdang stock	586
Total	2,915

Twenty-three Amelonado pods harvested from Field 44, Federal Experiment Station, Serdang, gave an average of 90.2 gms. of wet cacao per pod and 41.5 beans per pod. These figures are considered satisfactory for trees just coming into bearing.

Trinitario.

Observation of the various imported progenies continues. The Indonesian progenies, and some I.C.S.1 seedlings received via Kew, are now flowering freely.

Buddings.

At Degong, Perak, Trinitario stocks budded with Amelonado gave the following results:—

No. of buddings	1,645	
Successful unions	1,527	(92 per cent.)
Buds shot (to-date)	1,349	(82 per cent.)

Cuttings.

The success of the technique used for rooting cuttings is unpredictable From some batches of cuttings, 90 per cent. have been well rooted after 30 days; from other batches, only 40 per cent. have rooted. The reasons for this wide variation have not yet been determined. They appear to be related in part to prevailing climatic conditions.

Pest Control.

Work on *Apogonia,* a chafer beetle destructive to cacao leaves, has shown that two species, *A. cribricollis* Burm. and *A. expeditionis* Rits., are involved. These insects had previously been confused under the name *A. cribricollis* Burm. The life history of both species, which are so alike as to require dissection for their separation, is 7 to 10 days for the egg, 10 to 11 weeks for the grub and 11 to 12 days for the pupa, a total of 3½ months, all spent underground. Insecticidal trials are in progress.

Reports of damage by grasshoppers (*Catantops humilis* Serv.) to cacao grown under shade (where chafer damage is always less) were received from Trengganu with a request for a poison bait formula, because spraying or dusting the leaves was said to be impracticable. 6.5 per cent. gamma BHC was suggested.

Isolation Nursery, Pulau Tekong.

A consignment of Upper Amazon cacao and *Herrania* spp. seeds was received by air from West Africa in December, 1951, and planted at the Isolation Nursery. Unfortunately viability of the seeds was low, possibly owing to delay in transit, and germination has only been about 13.4 per cent. All seedlings so far appear healthy.

2. Agronomic Investigations.

Shade produced by quick-growing secondary forest, which regenerated after jungle felling without a burn, has been associated with very good cacao growth in an establishment experiment on a Trengganu estate. In the same trial, growth under the shade of 140 jungle trees to the acre has been poor but thinning to 70 trees to the acre has given better growth. Grasshopper damage to young trees under jungle has been quite serious.

In a shade and spacing experiment at the Federal Experiment Station, Gajah Mati, Kedah, plants received a severe set-back at the onset of hot, dry weather and some hand-watering with the provision of palm-leaf shade was required. It is possible that cacao cultivation techniques which are suitable in equatorial Malaya may have to be modified further north.

Amongst new cacao introductions, establishment and early growth of New Guinea and West African Trinitario at Serdang has been very satisfactory.

In a Serdang variety trial, testing Amelonado against local Trinitarios, damage by sucking bugs, especially *Gampsocoris pulchellus* Dall.

and *Helopeltis theobromae* Miller, has been severe and the spray programme has been altered accordingly.

Oil Palm.

1. Research.

Selection and Breeding.

A summary of the 1951 yield records of the Elmina progenies shows that the "Dumpy" progeny E. 206 is again one of the highest yielding, only E.152 x E.206 being superior.

The various nurseries and experiments on estates are progressing satisfactorily.

Oil Palm at various pH levels.

The pot experiments, using good jungle soil and liming, are still in progress. Observations of the growth of these palms seem to confirm the view that the oil palm grows best in acid soils.

Leaf Analyses.

As stated in the previous quarterly report, the results of analyses of the leaf samples from the three families E97, E207 and E268 have been analysed statistically and proved very interesting. The calcium content of the ash would appear to be directly related to bronzing, being highest in the case of the most severely bronzed palms. On the other hand, the potassium content would seem to be inversely related to bronzing. The phosphorus and magnesium contents appear not to be directly related to bronzing, but the K_2O/P_2O_5 ratio would seem to be directly connected with this pathological condition of the palm.

During the quarter, a further 30 of these leaf samples have been taken for analyses. These samples included those from the palms belonging to the two additional families E152 and E216 now included in the investigation.

The experiment to grow palms in a hydroponic solution with excess aluminium has been repeated. The palms would appear to be able to tolerate as high as 2 per cent. concentration of aluminium sulphate.

2. Agronomic Investigations.

In a drainage and arching experiment on an estate in Selangor, mechanical work by heavy track-tractors has caused soil consolidation, thus delaying planting.

In a replanting and manurial experiment at the Federal Experiment Station, Serdang, height measurements which were made on young palms in November, 1951, have now been analysed. The main treatments constitute different dates of felling of old palms but no significant differences were revealed. However, of the manurial sub-treatments, nitrogen gave a highly significant height increase but all other nutrient effects and interactions were insignificant.

Coconut.

1. RESEARCH.

Pest Control.

An attack of caterpillars of the slugworm or nettle caterpillar *Orthocraspeda trima* Moore on young coconuts in the Sabak Bernam area was visited by the Entomologist. This insect is rarely a severe pest but was doing damage in patches scattered over a 150 acres planting. Agrocide 3 was applied by means of a rotary duster. Amongst other insects was *Thosea* sp., previously recorded only from coffee, tea and cinnamon.

2. AGRONOMIC INVESTIGATIONS.

In an intercultivation experiment in north Selangor, tea seedling stumps were planted in January and are growing well, although casualties were high with the smaller stumps. Cacao seedlings were killed in the nursery by accidental watering with brackish water, but fresh seed has been supplied. The first batch of Liberian coffee seed germinated poorly but fresh seed has given better results.

Fibres.

1. RESEARCH.

Selection.

Ramie. A third crop has been harvested from the preliminary clonal trial and as a result six clones have been selected for field trials.

Disease Control.

Manila Hemp. A bacterial disease of Manila hemp occurring on a badly drained area at the Federal Experiment Station, Serdang, is being investigated. Bacteria from an affected plant, when inoculated into tomato plants, caused two plants out of four to wilt and die within eight days. It appears probable that the cause of the disease is *Xanthomonas solanacearum*, the common cause of bacterial wilt of tomatoes etc.

2. AGRONOMIC INVESTIGATIONS.

In a time-of-planting jute trial, the Indian varieties of *Corchorus capsularis* and *C. olitorius* continue to show no promise owing to early flowering and low branching. However, *C. capsularis* var. *Segama*, from Borneo, grows very well with unbranched growth to 6 feet and delayed flowering. This very promising strain has been included in a variety trial designed for the Selangor coast muck-soils.

Selections of *Urena lobata* from all parts of Malaya have shown no promise at all at Serdang, but a strain found recently growing wild near Kuala Lumpur has given a fine fibre sample of good lustre and length. Seed has been collected for observation in cultivation.

Tea.

1. RESEARCH.

Selection.

A further 11,252 cuttings have been taken for rooting trials of selected bushes at Cameron Highlands, making a total of 31,108. Of the 264 selections, 28 bushes have still failed to give suitable wood for cuttings. Of the 19,856 cuttings taken in November, some 57 per cent. show signs of survival, but individual bush progenies vary from 10 to 95 per cent. survival so far; final counts have yet to be made.

Disease Control.

Blister Blight. At Cameron Highlands the wet season at the end of 1951 and the beginning of 1952 was rather short and not severe, and was followed by very dry weather in February. As a result blister blight attack has not been so severe this season as last.

At the Agricultural Station, Tanah Rata, all experiments in the present series have been completed, except for the monthly pruning experiment in which yields of plucked leaf from sprayed and unsprayed plots are being recorded at each plucking. It is hoped to carry this experiment on through one complete cycle of three years. Despite the somewhat unfavourable weather, most of the experiments were subjected to fairly severe blister blight attack, unsprayed control bushes being badly affected, and it is hoped that useful results will be obtained from the eight experiments just completed. Results are being assembled. There have been no recent reports of blister blight occurring on the lowlands.

Pineapple.

1. RESEARCH.

Selection.

As a result of a study of variation in vegetative habit of the Singapore Canning variety in Johore, six types differing in compactness of habit have been picked out and material reserved for selection plots at the Federal Experiment Stations at Alor Bukit, Johore, and Jalan Kebun, Selangor.

Possible correlation between vegetative habit and time of fruiting is being investigated in view of the planters' opinion that erect-leaved plants are earlier fruiting.

Pilot survey of variation in fruit characters in the field has been continued and a more comprehensive survey both in the field and at canneries is to commence in April.

Observation plots have been selected on all plantations in South Johore to estimate yield and incidence of disease under as many different ecological conditions as possible.

Disease Control.

A visit was made by the Acting Senior Plant Pathologist to South Johore to investigate the disease position and to plan future work on pineapple diseases. Diseases requiring investigation are:

Green wilt. This mainly affects fairly young plants; the leaves of affected plants have an abnormally light green colour and are narrower and more upright than usual.

Heart rot. The bud and the base of the central leaves of young plants are affected by a soft, evil smelling rot.

Root rot. All the underground parts of the plants are affected by a soft rot.

Fruit collapse. Fruits nearing maturity are affected by a soft rot which causes all the internal tissues to decay. The rot develops very quickly and reduces the fruit to a soft pulpy mass within 24 hours.

The causes of these diseases are not yet known, but investigations on the more important of them are being commenced.

Specimens of pineapple leaves were received from an estate in Perak. They were affected by a leaf spot apparently caused by a species of *Curvularia.*

2. AGRONOMIC INVESTIGATIONS.

In a manurial trial on peat in south Johore, the application of potash has been shown to result in a significant decrease in the incidence of the serious disease Green Wilt.

Observations indicate that control of at least some diseases depends on improving conditions of growth by methods such as planting on ridges and improving drainage.

Selection of healthy planting material and treatment of slips with Bordeaux mixture have effected a marked improvement in health on one estate in Johore.

Fodders.

1. RESEARCH.

Fodder Grass Experiments.

Periodic samples of Guinea grass and Napier grass have been taken for analyses in connection with the several manurial experiments at the Federal Experiment Station, Serdang. In all, 66 samples have been analysed during the quarter.

In the case of Guinea grass, the samples from the plots with the higher rates of fertiliser gave consistently higher protein contents. The Napier grass experiment showed that it would be possible by heavy manuring to increase the protein content of the grass to about 17 per cent. on the moisture-free basis.

The results of analyses of leaves of *Flemingia* spp. at the Federal Experiment Station, Serdang, indicate that these leaves and twigs will not be toxic to livestock even if eaten in fair quantities. They are practic-

ally similar in composition to the leaves and shoots of the several Malayan trees which at present serve as useful adjuncts to the grasses and green fodders.

2. AGRONOMIC INVESTIGATIONS.

Fodder Grasses.

A mechanical intercultivation experiment with Guinea grass has been planted at Bukit Mertajam, thus duplicating the one already established at Serdang.

Leguminous Fodders and Green Manures.

Yields of Stylo at Melor, in Kelantan, have shown a marked decline and it is probable that regular manuring is required. Observations on different cutting intervals are being made in the same State.

The new introduction, *Sesbania speciosa*, is now seeding heavily with no insect damage such as is associated with most leguminous green manures in Malaya.

Pasture Grasses.

In a shade and variety trial, yields for the period February, 1950, to November, 1951, have now been analysed. The light-loving *Axonopus affinis* has outyielded the shade-loving *A. compressus* but there were no significant differences in yield between the shaded and non-shaded plots.

Miscellaneous Crops.

Soyabean.

Forty-seven single plant selections and seven bulk selections have been made from the Java strains harvested in October last. The former are being bulked for variety trials and selection is continuing on the latter.

Groundnut.

Selection work has been suspended but the 15 strains of mass selected seeds plus four more recent collections are being maintained.

Vegetables at Cameron Highlands.

Carrots. A spraying trial against leaf blight (*Alternaria dauci*) has been completed at Cameron Highlands. Good control of the disease was obtained with Perenox, and although infection only became severe towards the end of the experiment there is an indication that the yield of roots has been increased by spraying.

Celery. An experiment on the effect of spraying celery against leaf spot (*Septoria apii-graveolentis*) has been concluded. Complete control was not obtained but substantial increases in yield were achieved. Perenox was also used in this trial.

Miscellaneous Records.

Pest Control (Misc.).

Hippoboscid flies ("keds") were found as ectoparasites on Bali cattle (*Bos sondaicus*) at Serdang, but not on other livestock. They proved to be *Hippobosca equina* L., a species which has been distributed over most of the temperate and tropical parts of the world. A subsequent examination of Bali cattle at the Kuala Lumpur abattoir showed both *Hippobosca equina* and *H. variegata* to be present there.

Cloves.

A very small scale spraying test with Dieldrin and Gammalin, two recently available insecticides, was carried out in Penang in an attempt to kill the long-horned beetles *Aphrodisium brevicorne* Franz and *Niraeus tricolor* Newm. which lay eggs in crevices in the bark between February and April. Results, if any, should show in about six months.

Disease Control (Misc.).

Sclerotium rolfsii was found causing a basal rot of banana pseudostems in Perak.

Canning Research.

The emphasis during the first quarter of 1952 has shifted to fruit preparation and waste recovery. First runs have been made on the second "Ginaca" machine with better results, and statistical trials are in progress. Both commercial juice lines have been operated and useful information obtained. Both have shown that the success of juice packing operations depends more on the quality of the fruit coming into the cannery than on the complexity of the equipment provided to process it. The increase in mechanical complexity in cannery equipment is also emphasising the lack of skilled electrical and mechanical engineers on canners' payrolls. The inability of the owners to maintain and operate equipment often thwarts our desire and ability to demonstrate what can be done with the equipment.

During the period, the first samples of papaya fruits were received from Serdang, and a standard canning procedure has been adopted to preserve these fruits for comparison and selection when a reasonable number of examples and varieties have been harvested.

Livestock and Poultry.

Goats.

The following kids have been born at Serdang during the quarter:-

British Alpine pure-bred	....	1 male, 1 female.
Saanan pure bred	....	1 male.
Anglo Nubian pure bred	....	1 male, 1 female.
Saanan 7/8 bred	....	1 female.
Toggenburg 3/4 bred	....	2 hermaphrodites.
Toggenburg 5/8 bred	....	1 female, 2 hermaphrodites.

Saanan 5/8 bred	....	1 male, 1 female.
Various half-breds	....	4 males, 2 females.

Total milk production for the quarter was 6,576 lbs., with British Alpine Doe No. 4 yielding an average of 7.25 lbs. per day.

Poultry.

In a feeding and management trials of *kampong* and R.I.R. birds, the birds suffered considerable casualties and interpretation of the results will be difficult. At Bukit Mertajam, Province Wellesley, 19 birds died from poisoning and at Sg. Udang, Malacca, 4 birds died from Bacillary White Diarrhoea.

A strain trial of R.I.R. birds from five sources at Cheras has given interesting differences in average chick weights at four weeks old.

A duck trial with pure bred Pekins and 3/4 bred Khaki Campbells has commenced at Cheras, Selangor.

NOTES ON EXTENSION WORK, JANUARY TO MARCH, 1952.

Compiled by the Acting Chief Field Officer.

Padi.

Manuring.

Harvesting of the dry padi manurial trials on smallholders' land in Kelantan has started and should be completed shortly. The prospects of valuable results being obtained are good. Unfortunately for the wet padi trials in Kelantan and Trengganu, the season has been a very poor one and it is feared that many of them will not give satisfactory results. For example, in the district of Pasir Mas in Kelantan it has been reported that, although vegetative growth has been good on manured plots, all yields are low. Nevertheless, whatever the outcome, these series of trials have been effective in awakening interest in the manuring of padi, and groups of individuals have said that they wish to continue similar trials on their own land even if they have to purchase manures for the purpose.

Mechanical Cultivation.

The prolonged wet season made work difficult in most districts, but in spite of this, the number of tractors being used in smallholders' agriculture continues to increase. In Perak, for example, the Department of Agriculture is using seven Ferguson tractors and one Ransome M.G.5 tractor mainly for conducting pilot schemes on smallholders' land, and, as a result of these schemes, the Rural and Industrial Development Authority is operating six Ferguson tractors, while three are being employed in new villages. Again, in Pahang, two Ferguson tractors and two Ransome M.G.5 tractors are available for extension work; the Ferguson tractors are being used to train operators and cultivate smallholders' land in Jerantut in the first instance, while the M.G.5s are being used for work in areas where access by Ferguson tractor is not possible. One of the main obstacles in the early stages of these pilot schemes and projects is the inadequate training of operators, but there can be little doubt that mechanical cultivation for smallholders has come to stay.

Rubber.

Replanting and New Planting.

Smallholders still prefer to plant clonal seedlings rather than to bud in the field, and efforts are being made to increase the supply so that the demand may be met. During the period under review, some 70,000 clonal seedlings were distributed to smallholders and 179,000 germinated clonal seeds were planted, mainly in smallholders' nurseries. These communal seed nurseries are proving popular and, in addition to

the many in Kelantan, there are now 20 in Pahang and 13 in Johore. During the quarter, 233 acres in Kelantan were planted with seedlings from these nurseries. Owing to the present shortage of clonal seed, a pilot scheme for the production of 30,000 stumped buddings is being started in Pahang. Greater attention is being paid to new and re-planting in most States and an interesting advance is shown by the smallholders combining into Associations for the purpose; there are two such replanting Associations in Perak.

Processing and Marketing.

There has been some expansion in the numbers of both central processing schemes and latex selling schemes, and many of the former are now being organised by or are under consideration by the Rural and Industrial Development Authority. In Selangor the latex selling schemes are proving more popular than the processing schemes.

General.

The co-operation between the Department of Agriculture and the Smallholders' Advisory Service of the Rubber Research Institute remains close and smallholders are being helped in many ways in addition to the provision of improved planting material and the organisation of processing schemes. For example, during the period under review some 20 tons of manures and considerable quantities of cover crop seeds were ordered on behalf of rubber smallholders.

New Villages.

In many States and Settlements greater attention is now being paid to the provision of sufficient areas of good land for the economic development of new villages. Attempts are being made to improve the type of agriculture; for example, in the new village at Sungei Buloh in Selangor, an Agricultural Station is being opened in the fenced area, and on it, vegetable growing and the rearing of pigs, poultry, ducks and fish will be demonstrated, while in addition it will act as a centre for tractors which will be made available to the settlers. Again, in Malacca, distribution of soya bean seed in small quantities for demonstration purposes has resulted in a further large demand for seed and a small free supply of fertilisers and insecticides has resulted in orders for considerable quantities being placed by the settlers themselves.

Cacao.

It has been decided that Amelonado cacao, which comes true from seed, is likely to prove the most valuable type for planting by smallholders. Arrangements are being made to open Cacao Stations in all States and Settlements for the purpose of multiplying this type so that supplies of good planting material may be available in the event of cacao proving a satisfactory smallholders crop. Some of these nurseries have already been planted, and it is hoped that all of them will be planted by October or November this year.

Pineapples.

The new Pineapple Industry Ordinance became law in February, 1952, and considerable time was spent in Johore and Selangor in explaining the details of it to the planters and smallholders concerned. This was done by means of the distribution of leaflets, in both Malay and Chinese, and by the holding of meetings. In general the Ordinance was well received by smallholders.

Livestock.

The demand for Middle White boars and gilts remains high and 35 were sold for breeding during the period. Stud boars are now being provided in those new villages in which pig breeding is one of the main lines of agriculture.

General.

Adult education continued in all its many forms. For example, a visit was arranged for 100 students and teachers from Penang Free School to the Agricultural Station, Ayer Itam, Penang, where lectures and demonstrations on fruit propagation and general agriculture were given. Other organised trips were arranged for Resettlement Officers and Chinese squatters from the Dindings to the pig breeding areas in Bayan Lepas, Penang, and for a party of penghulus and ketuas from the Endau padi area in Johore to Tanjong Karang in Selangor. Arrangements are being made for two penghulus from Langkawi Island, off Kedah, to visit the Kelantan coastal plain for the purpose of studying dry padi cultivation. Lectures on general agriculture or on specific problems were regularly given in schools and outside mosques, and full use was made of the Public Address Van, operated by the Department of Information, whenever it visited States and Settlements. During the period under review, special lectures were given by officers of the Department at the Training School for Assistant Resettlement Officers in Taiping, at the Rural and Industrial Development Authority's Ketua Course in Ipoh, and at a Student Teachers' Course at Machang in Kelantan.

A new venture was the production of a quarterly news letter issued by the Departments of Agriculture in Kedah and Perlis. The number of copies of the second edition, produced in January, was 2,500 and, as far as it is possible to judge at present, it would seem that the publication is being favourably received by the farmers.

A special Agricultural Day was organised at the Federal Experiment Station, Titi Serong, in Krian, where a large audience showed great interest in the finer points of padi selection work. Successful Agricultural Shows were held at Telok Datoh and Batang Kali in Selangor.

School garden competitions were as usual held in all States and final judging took place in Perlis, Kedah, Selangor and Malacca. Agricultural Stations were visited by people of all races whose main desire seemed to be to obtain poultry and budded fruit trees.

Departmental Notes

The Retirement of Dr. A. E. S. McIntosh, B.Sc. (Hons.), Ph.D.

Dr. A. E. S. McIntosh, Mac to the Department, arrived in Malaya in 1945 to fill the post of Senior Agricultural Officer. When the new post of Deputy Director was created in 1946, Mac was selected to be its first incumbent.

The qualities of thoroughness and close attention to detail—the hall-mark of all good plant breeders—had been clearly shown by him during his long service with and later direction of the British West Indies Central Sugarcane Breeding Station in Barbados. These qualities he brought with him to Malaya when the Department was soon made to feel his burning desire to concentrate its activities on research and investigation. He was not slow to put forward these views when the opportunity was afforded him by his selection as one of a commission of two to report to the Colonial Office on the possibilities of regional agricultural and veterinary research in British South East Asia. The recommendations of that commission were not wholly accepted by the Federal Government, but they did form the basis of the Development Plan insofar as it concerned the organisation of the Department.

With all his concentration on fundamental and applied research, Mac was by no means heedless of the political events around him. His experience in the West Indies had taught him that, in the long run, the status of Departments of Agriculture rested more on what the farming community thought than on what might be the prevailing view in the secretariat. He therefore welcomed all moves which brought into political power those with a practical knowledge of farming conditions in Malaya. Holding these views, it is surprising that Mac showed comparatively little interest in our extension activities, since it is only by these that the rayat or estate manager can judge the effectiveness of the Department.

Mac was a strict disciplinarian and never sought popularity. His inability to unbend and his distinct proclivity to lengthy exposition both in talk and in writing made one feel that one was dealing with the family lawyer; but just as that austere personage has the safeguarding of the family interests as his first concern, so Mac jealously guarded the interests of all in the Department from peon upwards.

Mac's retirement on medical grounds has come at a time when great changes are taking place in Malaya. These have called for new thinking within the Department and Mac has made a potent contribution thereto. It is our hope that in retirement he will find congenial employment for his considerable mental talents—not least of such enjoyment being, no doubt, long and incontestable arguments with the Inland Revenue Officials. He will certainly, too, be a frequent visitor to Murrayfield where he will follow with the keenest interest the fortunes of Scottish

rugger. After 24 years in the service of tropical agriculture we wish him well deserved happiness and prosperity—if such a term can ever apply to colonial pensioners—in the more temperate climate of his native land.

O.J.V.

Appointments.

Mr. Gunn Lay Teik, O.B.E., Senior Chemist, has been appointed to act as Senior Chemist (Soils), in addition to his own duties, with effect from the 18th February, 1952.

Mr. E. J. H. Berwick, Senior Agricultural Officer, has been appointed to act as Chief Field Officer, in addition to his own duties, with effect from the 26th March, 1952.

Mr. P. G. Coleman, Agricultural Officer, has been appointed to act as State Agricultural Officer, Kedah and Perlis, with effect from the 29th March, 1952.

Leave.

The following officers have proceeded on vacation leave:—

Mr. J. R. Curry, Senior Agricultural Officer, with effect from 27th March, 1952.

Mr. J. Cook, Senior Agricultural Officer, with effect from the 31st March, 1952.

Mr. J. K. Coulter, Chemist (Soils), with effect from the 20th February, 1952.

MARKET PRICES

January to March, 1952.

Rubber.—The new year commenced with the Singapore price of No. 1 R.S.S., f.o.b., in bales at 140 cents per lb., and although the price had risen to 142⅜ cents by the 11th January there was a gradual decline to 138⅞ cents at the end of the month. The average price for January was 140.17 cents.

February's average price was 20 cents below that in January. The month started with the price at 138⅛ cents and it had decreased to 108 cents by the 19th. On the 20th it rose to 116 cents but by the end of the month it had dropped to 108½ cents per lb.

In March, the price remain comparatively constant, being 110 cents at the beginning and 112 cents at the close of the month. The average price for the month was 111.42 cents per lb.

The average prices paid for smallholders' rubber at three centres in the Federation of Malaya during the first quarter of 1952 are given in Table I.

Table I.

Average Monthly Prices Paid by Local Dealers for Smallholders' Rubber, January to March, 1952.

(Dollars per picul of 133 1/3 lbs.)

Grades.	Taiping, Perak.			Seremban, Negri Sembilan.			Batu Pahat, Johore.		
	Jan.	Feb.	Mar.	Jan.	Feb.	Mar.	Jan.	Feb.	Mar.
Smoked Sheet	145.00	113.00	117.00	156.50	131.00	120.00	125.63	102.50	104.00
Unsmoked Sheet	122.50	90.00	103.00	130.00	108.00	99.00	121.44	89.69	81.50
Scrap	47.50	27.50	35.00	58.00	35.00	33.00	30.00	22.59	17.50

Transport from Batu Pahat to Singapore by lorry, excluding duty, $1.25 per picul.

Tea.—There have been no quotations for Malayan tea in recent issues of the weekly report of the Colombo Brokers' Association. In the report for the 25th March, 1952, the average prices of Ceylon teas were as follows, in rupees per lb.: High Grown Teas 2.07, Medium Grown Teas 1.60, and Low Grown Teas 1.45.

Derris.—The price of derris, as quoted in the weekly reports of the Singapore Chamber of Commerce, has remained steady at $150 per picul during the first quarter of the year.

Tobacco.—The average prices paid per picul for cured leaf in Kelantan were:—1st quality $700, 2nd quality $266 and 3rd quality $91.

Rice.—The ration of rice has remained at 3½ katis per person per week. The range of prices, in cents per kati, of the three grades of ration rice are as follows:—High Grade 32 to 36, Medium Grade 25 to 30, and Low Grade 19 to 21.

Table II.

Singapore Prices of Various Agricultural Products.

(Dollars per picul)

Date	Copra, Sundried	Coconut oil*	Pepper. F.A.Q. Muntok white	Pepper. Gen. Muntok white	Gambier, Cube	Sago Flour, Lingga	Tapioca Flour No. 1	Oilcake, Round
1952								
2nd Jan. -	36.75	64.50	755.00	765.00	83.00	16.25	38.00	20.00
7th Jan. -	36.50	63.50	765.00	775.00	83.00	16.00	38.00	20.00
14th Jan. -	40.25	64.00	800.00	805.00	83.00	16.25	38.00	20.00
21st Jan. -	35.75	62.50	830.00	840.00	83.00	16.25	37.50	20.00
30th Jan. -	32.50	58.00	810.00	820.00	84.00	16.25	37.00	19.75
4th Feb. -	30.00	55.00	820.00	830.00	83.00	16.25	37.00	20.00
11th Feb. -	30.00	52.50	795.00	805.00	84.00	16.25	37.50	20.00
18th Feb. -	28.25	51.00	805.00	815.00	84.00	15.00	37.00	21.00
25th Feb. -	25.75	47.00	730.00	740.00	84.00	15.25	37.50	23.00
3rd Mar. -	25.25	45.00	745.00	755.00	82.00	15.00	37.00	22.50
10th Mar. -	27.50	45.00	705.00	710.00	82.00	14.50	37.00	22.00
17th Mar. -	28.00	44.50	630.00	640.00	81.00	14.50	37.00	20.50
24th Mar. -	28.50	43.50	635.00	645.00	81.00	14.25	37.00	20.50
31st Mar. -	28.00	43.00	635.00	645.00	82.00	14.00	36.00	21.50

* F.O.B.

The above prices are taken from the weekly reports of the Singapore Chamber of Commerce.

FEDERATION OF MALAYA
PRODUCTION OF PALM OIL AND KERNELS.
(In long tons as declared by Estates)

Month	Palm Oil		Palm Kernels	
	1951	1952	1951	1952
January	4,068	3,182	997	839
February	3,510	3,110	813	850
March	3,821	3,327	940	865
April	3,732	3,350	896	893
May	4,260		1,029	
June	3,295		801	
July	3,249		781	
August	3,913		946	
September	4,614		1,125	
October	4,854		1,172	
November	4,495		1,151	
December	4,463		1,120	
Total	48,274	(12,969)	11,771	(3,447)

In April, 44 estates (planted area 93,035 acres) were in production out of a total of 52 oil palm estates (planted area 97,503 acres).

MALAYAN AGRICULTURAL EXPORTS, OCTOBER-DECEMBER, 1951.

Product	Net Exports in Tons.			
	Year 1949	Year 1950	Oct.-Dec., 1950	Oct.-Dec., 1951
Arecanuts	5,607	14,867	4,385	2,858
Coconuts, fresh †‡	21,971 †	36,917 †	8,229	11,899
Coconut oil ‡	60,504	56,046	17,601	21,088
Copra ‡	24,424 *	4,778	1,894 *	5,372 *
Copra cake	27,643 *	31,104 *	8,245 *	9,289 *
Gambier, all kinds	294	331	1	2 *
Palm Kernels	8,744	9,070	1,432	3,454
Palm Oil	55,211	50,638	12,590	13,495
Pineapples, canned	8,130	14,666	2,060	2,335
Rubber ¶	670,257 ¶	692,585 ¶	190,993 ¶	149,528 ¶
Sago,—flour	1,476	12,006	4,480	4,789
„ —pearl	3,477	1,664	603	1,066
„ —raw	1,316 *	15,693 *	6,112 *	6,787 *
Tapioca,—flake	737	1,098	208	115 *
„ —flour	278 *	2,782 *	142 *	1,534 *
„ —pearl	12,346	13,507	3,050	2,056
Derris	48	44	—	2
‡ Copra equivalent	74,334	96,591	26,872	29,134

¶ production (Federation of Malaya). † hundreds in number. * net imports.

FEDERATION OF MALAYA RUBBER PRODUCTION.

(In long tons, dry weight)

Month	Estates		Smallholdings (Estimated)		Total	
	1951	1952	1951	1952	1951	1952
January	29,482	27,044	26,588	23,770	56,070	50,814
February	26,519	24,007	22,468	19,200	48,987	43,207
March	30,591	25,679	28,000	20,810	58,591	46,489
April	24,470	25,533	22,005	19,729	46,475	45,262
May	24,227		20,124		44,351	
June	28,141		24,498		52,639	
July	27,286		21,097		48,383	
August	27,330		24,500		51,830	
September	26,293		20,733		47,026	
October	27,622		22,509		50,131	
November	26,690		20,502		47,192	
December	29,305		22,900		52,205	
Total	327,956	(102,263)	275,924	(83,509)	603,880	(185,772)
Total 1950	375,853		316,732		692,585	

This Table has been compiled from statistics published by the Registrar of Statistics, Federation of Malaya.

Smallholding production is estimated from purchases reported by dealers.

FEDERATION OF MALAYA

PRODUCTION OF COPRA, COCONUT OIL AND COPRA CAKE.

(in tons)

Month	Copra Production						Coconut Oil Production		Copra Cake (Poonac) Manufactured	
	Estates		Smallholdings (estimated)		Total		Oil Mills		Oil Mills	
	1951	1952	1951	1952	1951	1952	1951	1952	1951	1952
January	2,346	2,740	8,501	9,296	10,847	12,036	5,537	6,681	3,532	4,244
February	2,516	2,777	6,323	8,510	8,839	11,287	4,856	6,338	3,072	4,016
March	3,059	2,864	9,078	8,522	12,137	11,386	5,752	5,616	3,784	3,647
April	2,888	2,964	7,832	8,684	10,720	11,648	5,714	6,128	3,585	3,949
May	3,200		10,764		13,964		6,718		4,342	
June	3,692		9,518		13,210		7,287		4,716	
July	4,083		11,580		15,663		8,571		5,567	
August	4,044		11,756		15,800		8,552		5,569	
September	3,777		10,551		14,328		7,833		5,043	
October	3,402		12,186		15,588		8,543		5,570	
November	3,245		10,392		13,637		8,491		5,456	
December	3,170		12,139		15,309		8,543		5,425	
Total	39,422	(11,345)	120,620	(35,012)	160,042	(46,357)	86,397	(24,763)	55,661	(15,856)

Notes:—1. The above statistics are compiled and published by the Registrar of Statistics, Federation of Malaya.

2. Estate copra production and coconut oil production are as declared by estates and oil mills respectively.

3. Statistics of smallholding coconut oil production are not available.

4. Smallholding copra production for commercial purposes is estimated from the formula: imports + estate stocks (opening) + estate production + smallholding production = exports + local oil mill consumption + estate stocks (closing).

FEDERATION OF MALAYA

Padi Statistics, 1951-52 Season.

Acreages of Wet Padi Harvested Monthly and Estimated Yields.

State	Total Planted Area (acres)	Total to 31st March, 1952.			April, 1952.			Total to 30th April, 1952.		
		Area Harvested (acres)	Per cent (3)-(2)	Estimated average Yield per acre (gantangs)	Area Harvested (acres)	Per cent (6)-(2)	Estimated average Yield per acre (gantangs)	Area Harvested (acres)	Per cent (9)-(2)	Estimated average Yield per acre (gantangs)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Perlis	48,204	43,151	89.5	282	35	.1	229	43,186	89.6	282
Kedah	280,476	264,063	94.2	329	12,689	4.5	203	276,752	98.7	323
Kelantan	140,970	71,950	51.0	200	59,640	42.3	184	131,590	93.3	192
Trengganu	46,700	14,186	30.4	194	18,092	38.7	224	32,278	69.1	211
Penang & P. Wellesley	38,874	21,694	55.8	284	14,414	37.1	217	36,108	92.9	257
Perak	96,546	59,202	61.3	240	28,105	29.1	145	87,307	90.4	209
Selangor	48,292	30	.1	320	10,846	22.5	383	10,876	22.6	383
Pahang	25,321	23,439	92.6	213	917	3.6	248	24,356	96.2	214
Negri Sembilan	27,764	23,051	83.0	237	271	1.0	129	23,322	84.0	235
Malacca	29,546	13,678	46.3	195	2,772	9.4	285	16,450	55.7	210
Johore	1,531	792	51.7	137	177	11.6	44	969	63.3	120
Total	784,224	535,236	68.2	280	147,958	18.9	203	683,194	87.1	263

FEDERATION OF MALAYA

Padi Statistics, 1951-52 Season.

Acreages of Dry Padi Harvested Monthly and Estimated Yields.

State	Total planted area (acres)	Total to 31st March, 1952.			April, 1952.			Total to 30th April, 1952.		
		Area Harvested (acres)	Per cent (3)-(2)	Estimated average Yield per acre (gantangs)	Area Harvested (acres)	Per cent (6)-(2)	Estimated average Yield per acre (gantangs)	Area Harvested (acres)	Per cent (9)-(2)	Estimated average Yield per acre (gantangs)
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Perlis	87	87	100.0	168	—	—	—	87	100.0	168
Kedah	2,368	2,368	100.0	179	—	—	—	2,368	100.0	179
Kelantan	28,519	28,437	99.7	143	—	—	—	28,437	99.7	143
Trengganu	8,152	8,152	100.0	151	—	—	—	8,152	100.0	151
Penang & P. Wellesley	60	60	100.0	98	—	—	—	60	100.0	98
Perak	452	375	83.0	168	44	9.7	53	419	92.7	156
Selangor	—	—	—	—	—	—	—	—	—	—
Pahang	1,010	1,010	100.0	133	—	—	—	1,010	100.0	133
Negri Sembilan	27 *	—	—	—	—	—	—	—	—	—
Malacca	3	—	—	—	—	—	—	—	—	—
Johore	5	4	80.0	79	1	20.0	58	5	100.0	75
Total	40,683	40,493	99.5	147	45	.1	53	40,538	99.6	147

* 24 acres abandoned due to the Emergency, and 3 acres destroyed by pests.

METEOROLOGICAL SUMMARY, MALAYA, FEBRUARY, 1952.

Locality	Air Temperature degrees Fahrenheit							Earth Temperature		Rainfall									Bright Sunshine		
	Means of			Absolute Extremes						Total		Most in a day	Number of days						Total	Daily Mean	Per cent.
	A. Max.	B Min.	Means of A and B	Highest Max.	Lowest Min.	Lowest Max.	Highest Min.	At 1 foot °F	At 4 feet °F			Amt.	Precipitation .01 in or more	Precipitation .04 in or more	Thunderstorm	Fog morning obs.	Gale force 8 or more				
										ins.	mm.	ins.							hrs.	hrs.	
Ipoh, Perak	91.4	72.7	82.1	94.4	70.0	86.4	75.1			5.24	133.1	0.98	17	15			1		173.95	6.00	
Port Swettenham, Selangor	89.0	73.3	81.1	92.8	71.7	85.5	75.5	83.5	84.5	13.36	339.3	2.52	18	17	4	1			162.30	5.60	
Kuala Lumpur, Selangor	90.9	73.5	82.2	94.9	71.2	84.8	75.5			5.59	142.0	1.55	18	11	3	3					
Sitiawan, Perak	88.6	73.0	80.8	92.2	70.6	83.0	75.2	84.6	85.5	11.68	296.7	1.62	20	19	3	2			167.60	5.78	
Kuala Lipis, Pahang	86.1	72.0	79.1	91.1	68.8	79.0	74.7	83.0	83.4	8.65	219.7	2.22	21	18		28			118.70	4.09	
Kuantan, Pahang	85.5	72.7	79.1	89.4	67.0	79.0	75.7			12.52	318.0	1.33	25	23	2	1			105.75	3.65	
Temerloh, Pahang	87.1	71.8	79.5	92.4	68.2	81.2	74.2			9.88	251.0	2.50	23	21		7			125.90	4.34	
Bayan Lepas, Penang	88.8	74.5	81.7	91.2	71.0	83.3	76.5			8.78	223.0	2.70	15	14	1				207.75	7.16	
Malacca	87.4	73.1	80.3	91.8	70.8	84.0	75.0			11.73	297.9	6.03	16	15			1		173.45	5.98	
Mersing, Johore	83.4	74.1	78.7	87.9	71.4	79.2	77.9			14.55	369.6	4.17	22	19	1		2		137.35	4.74	
Alor Star, Kedah	92.9	71.9	82.4	96.1	66.4	88.3	75.8			3.77	95.8	2.46	9	6	1				205.90	7.10	
Kota Bharu, Kelantan	86.5	75.2	80.9	88.8	70.4	82.0	78.6	85.7		4.02	102.1	1.21	16	11		2			183.50	6.33	
K. Trengganu, Trengganu	84.7	74.5	79.6	87.1	70.2	78.3	78.0			11.82	300.2	4.07	19	14		2			168.45	5.81	
Kallang Aerodrome (S'pore)	86.5	74.3	80.4	91.0	72.5	78.4	76.8			11.45	290.8	2.44	22	17	1				125.70	4.33	
HILL STATIONS.																					
Fraser's Hill, Pahang 4268 ft.	70.7	60.7	65.7	75.3	57.1	66.2	63.2	71.3	71.5	17.38	441.5	4.40	20			19			96.20	3.32	
Cameron Highlands, Tanah Rata, Pahang 4750 ft.	72.4	57.7	65.1	75.2	47.9	66.8	63.4	66.6	68.3	3.47	88.1	0.48	16	16	2	1			125.35	4.32	

Compiled from Returns supplied by the Malayan Meteorological Service.

METEOROLOGICAL SUMMARY, MALAYA, MARCH, 1952.

Locality	Air Temperature degrees Fahrenheit							Earth Temperature		Rainfall									Bright Sunshine		
	Means of			Absolute Extremes						Total		Most in a day	Number of days						Total	Daily Mean	Per cent.
	A. Max.	B. Min.	Means A and B	Highest Max.	Lowest Min.	Lowest Max.	Highest Min.	At 1 foot °F	At 4 feet °F			Amt.	Precipitation .01 in or more	Precipitation .04 in or more	Thunderstorm	Fog morning obs.	Gale force 8 or more				
										ins.	m m.	ins.							hr.	hr.	
Ipoh, Perak	92.6	73.2	82.9	96.2	70.8	88.9	75.1			15.67	398.0	3.95	21	20	10	1	2		206.55	6.66	
Port Swettenham, Selangor	90.2	73.8	82.0	93.0	71.5	86.9	75.9	85.6	85.0	5.19	131.8	1.81	11	8	2	1			199.20	6.43	
Kuala Lumpur, Selangor	91.8	73.8	82.8	95.0	71.3	87.9	76.0			7.38	187.5	2.26	19	13	10	5					
Sitiawan, Perak	90.1	73.7	81.9	93.8	70.1	87.3	76.0	85.7	85.8	2.98	75.7	0.67	16	11		1			218.30	7.04	
Kuala Lipis, Pahang	89.8	72.6	81.2	92.3	70.6	83.7	74.8	84.7	84.3	13.96	354.6	5.38	22	24	3	26			185.95	6.00	
Kuantan, Pahang	88.5	72.5	80.5	91.3	69.3	85.3	75.6			5.40	137.0	1.23	17	13		1			183.10	5.91	
Temerloh, Pahang																					
Bayan Lepas, Penang	88.2	75.0	81.6	90.3	71.6	85.2	77.8			13.23	336.0	4.71	21	14	2				222.30	7.17	
Malacca	87.1	74.0	80.5	91.0	71.5	83.1	75.9			6.40	162.6	1.38	17	14	2				215.75	6.96	
Mersing, Johore	85.9	72.9	79.4	88.9	70.4	82.3	75.9			5.24	133.1	1.75	15	13	1				204.10	6.75	
Alor Star, Kedah	92.1	73.2	82.7	95.2	71.1	87.2	75.1			9.86	250.4	2.52	15	13	2	1			229.30	7.40	
Kota Bharu, Kelantan	88.2	73.9	81.1	90.4	71.8	84.5	76.0	87.1		1.77	45.0	0.87	8	7	1	3			253.70	8.18	
K. Trengganu, Trengganu	86.9	73.4	80.1	89.0	71.2	82.8	74.9			8.51	216.2	2.91	12	11	3	4			255.75	8.25	
Kallang Aerodrome (S'pore)	87.4	74.6	81.0	90.2	70.8	80.0	77.3			13.19	335.0	2.28	21	19	10		1		192.40	6.41	
HILL STATIONS.																					
Fraser's Hill, Pahang 4268 ft.	73.4	62.2	67.8	77.1	60.0	68.1	64.0	71.6	71.9	13.18	334.8	2.40	23			10			122.70	3.96	
Cameron Highlands, Tanah Rata, Pahang 4750 ft.	73.4	56.8	65.1	77.2	50.8	70.4	62.0	67.3	68.6	20.24	514.1	3.08	24	24	1	2					

Compiled from Returns supplied by the Malayan Meteorological Service.

METEOROLOGICAL SUMMARY, MALAYA, APRIL, 1952.

Locality	Air Temperature degrees Fahrenheit							Earth Temperature		Rainfall								Bright Sunshine		
	Means of			Absolute Extremes									Number of days							
	A. Max.	B. Min.	Means of A and B	Highest Max.	Lowest Min.	Lowest Max.	Highest Min.	At 1 foot °F	At 4 feet °F	Total		Most in a day Amt.	Precipitation .01 in or more	Precipitation .04 in or more	Thunderstorm	Fog morning obs.	Gale force 8 or more	Total	Daily Mean	Per cent.
										ins.	m m.	ins.						hr.	hr.	
Ipoh, Perak	92.0	74.0	83.2	95.1	72.2	88.2	76.8			12.92	328.2	3.35	22	17	7			207.05	6.90	
Port Swettenham, Selangor	90.1	73.7	81.9	92.9	70.9	85.2	76.0	85.1	85.5	10.08	256.0	2.72	21	18	8	2		205.55	6.85	
Kuala Lumpur, Selangor	91.3	73.9	82.6	93.3	71.9	87.9	76.4			12.18	309.4	2.41	26	22	13	9				
Sitiawan, Perak	89.8	73.9	81.9	93.8	70.8	83.6	76.0	86.3	86.6	9.26	235.2	2.96	19	16	7			215.15	7.17	
Kuala Lipis, Pahang	90.5	72.7	81.6	93.2	70.2	85.0	75.6	85.6	85.4	9.22	234.2	2.35	22	22	7	25		197.80	6.59	
Kuantan, Pahang	89.5	72.7	81.1	92.2	70.4	82.3	74.8			7.76	197.1	2.39	12	12	1	4		202.45	6.75	
Temerloh, Pahang																				
Bayan Lepas, Penang	88.4	75.9	82.1	90.5	73.0	86.0	78.4			9.40	238.8	2.50	19	17	4			242.40	8.08	
Malacca	86.7	74.4	80.5	89.7	72.5	82.8	77.1			9.60	243.8	1.96	19	17	4		2	227.10	7.57	
Mersing, Johore	88.1	73.2	80.7	91.3	71.3	82.7	74.6			6.76	171.7	3.55	14	9	2			231.20	7.71	
Alor Star, Kedah	91.4	74.5	82.9	94.4	72.2	85.7	76.8			11.57	293.9	3.78	14	13	2	1		252.15	8.41	
Kota Bharu, Kelantan	91.3	74.5	82.9	94.3	71.8	88.2	76.0	90.5		1.88	47.8	1.20	5	4	1	1		261.35	8.71	
K. Trengganu, Trengganu	88.7	73.8	81.3	90.9	72.0	78.9	75.1			4.37	111.0	1.60	12	8	1	1		247.35	8.25	
Kallang Aerodrome (S'pore)	88.2	76.0	82.1	90.9	72.4	80.0	79.9			5.52	140.2	2.26	11	9	5			192.40	6.41	
HILL STATIONS.																				
Fraser's Hill, Pahang 4268 ft.																				
Cameron Highlands, Tanah Rata, Pahang 4750 ft.	74.6	58.7	66.7	77.2	53.2	70.6	62.2	69.0	69.3	7.86	199.6	1.42	23	20	1	4		170.10	5.67	

Compiled from Returns supplied by the Malayan Meteorological Service.